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THE EMERYVILLE SHELLMOUND

BY

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CONTENTS.

Introduction.

California has but few characteristic archaeological remains such as are found in the mounds of the Mississippi valley or the ancient pueblos and cliff-dweller ruins of the South. In the shell-mounds along this section of the Pacific coast it possesses, however, valuable relics of very ancient date. These are almost the only witnesses of a primitive stage of culture which once obtained among the early inhabitants of this region.

Some years ago Professor Merriam recognized the necessity of exploring these ancient mounds and represented the facts to the University of California. Mrs. Phoebe A. Hearst generously made the undertaking possible by providing ample financial support for the exploration work.

One of the largest and best preserved shellmounds was selected

as the object of the present investigation, which was entrusted to Professor Merriam and the writer. The mound selected is situated on the eastern side of the Bay of San Francisco at Shellmound Station near Emeryville, and is commonly known as the Emeryville mound. At present it forms a conspicuous feature of the recreation grounds known as Shellmound Park (pl. 1).

The water of the bay rises to within 130 feet of the base of the mound (pl. 3) during high tide. The beach is then only one foot above the water level, while the ground in the immediate vicinity of the mound is from two to three feet higher. This ground is quite level and forms a part of an extensive alluvial flat. A small creek, having its source about three miles away, in the hills back of Berkeley, passes the mound on its south side, at a distance of two hundred feet, and empties into the bay. In summer the creek runs dry, but its bed furnishes a channel for subterranean water. Another, lower mound, containing graves, lay on the site of the Emeryville race-track near by, but it has been leveled down during the construction of the track. The shellmound which was the object of the excavation has the form of a truncated cone, with a diameter of 270 feet at its base and 145 feet at the top, and rising 27 feet above the plain. On the north side its foot extends 100 feet farther over the flat, a few feet higher than the level of the ground about it.

Twenty-five or thirty years ago the shore line of the bay lay fifty feet farther out; a pile set at that time is still to be seen at that distance from the beach. It is above the water during high tide and marks the coast line on this side of which floodland was sold by the State. The top of the mound was not at that time crowned by the wooden pavilion which is there at the present time. It was still ungraded, having its natural conical form, and was covered with a wild growth of bushes and brambles. The creek, as yet unregulated, followed its own course and overflowed the land, causing it to become marshy. In the seventies and eighties of the last century, railroad tracks were laid along the eastern side of the mound, and took in a section of its eastern foot. At that time a number of graves and Indian artifacts were discovered. Few of these, however, found their way into the collections of the University, then but recently founded.

Map of the east shore of San Francisco Bay in the vicinity of Berkeley, showing the location of the Emeryville Shellmound with several others in this region. Scale: 1 inch = about three miles.

Early Settlements in the Region.

Fages, the first traveler who passed through the country, from south to north, traveled along the eastern shore of the Bay of San Francisco in 1774,[1] and came upon Indian settlements where he found a friendly welcome. His account of this expedition, however, fails to throw any light upon the question whether or not the shellmounds were still occupied at that time. The neighboring creek bears the name of "Temescal" from a region between Berkeley and Oakland through which it passes.[2] This name appears to be a mutilation of the Nahua word "temazcalli," hothouse, the name of sweat-houses in Mexico, and the place may have been so named by Mexicans living on the Bay, from an Indian sweat-house standing there. Hence it may be assumed that an Indian settlement was in existence on the banks of this creek at a time from which the name could pass over into the existing vocabulary.

Other evidences of early Indian settlements in this section of the eastern shore country of the Bay are the shellmounds, twelve of which may be found along the coast between Point Richmond and Alameda in a stretch of twelve miles (pl. 1). They may be seen near Point Richmond upon the eastern side, facing the peninsula, upon Brooks Island, near Ellis Landing, northeast from Stege upon a marshy ground intersected by narrow channels, near Seaver's Ranch to the west from Stege, on Point Isabel, in West Berkeley, in Emeryville, and in the eastern section of Alameda between Mound, Central, and Lincoln avenues. There is also said to have been one in East Oakland on the canal between Oakland Harbor and Lake Merritt, but it has disappeared owing to building over that section of ground. In all probability many others may have met with a similar fate.

All these evidences of an early occupation of the country are but a few of the mounds that skirt the Bay upon all sides, continuing along Suisun Bay and the Sacramento and Feather rivers. Besides these, there are numerous mounds dotting the coast land

[1] Cf. H. H. Bancroft, The Native Races, 1886, II, p. 595.

[2] Cf. also "San Francisco Quadrangle" with the topographical maps of California by the U. S. Geological Survey.

of Northern California, those surrounding swamps and rivers along the Tulare and Kern lakes in southern California,[3] and on the shore near Santa Cruz. Others are found in the regions of San Luis Obispo,[4] of Santa Barbara,[5] and the islands opposite that place.

Early References to Shellmounds of Middle California.

All the publications treating of the shellmounds of central and northern California, which from the nature of their contents are different from those of the coast and the islands of southern California, may be condensed into the following bibliography:

The Smithsonian Reports of 1869 mention a collection of artifacts from the shellmounds of Alameda county presented to the Institute by Dr. Yates.[6] J. W. Foster, in 1874, speaks of a newspaper notice concerning a shellmound in the region of San Pablo.[7] James Deans follows in 1876 with a short notice (together with drawings of some artifacts) concerning a mound between Visitacion Valley and Point Bruno on the western shore of the Bay.[8] A short notice by H. H. Bancroft, accompanied by views of four objects, points to the great historical value of the shellmounds.

[3] Warren K. Moorehead, Prehistoric Implements, 1900, p. 258.

[4] Paul Schumacher, Smithson. Reports, 1874, p. 335 ff.

[5] Schumacher, Bulletin of the U. S. Geol. and Geogr. Survey of the Territories (F. V. Hayden), 1877, III, p. 73 ff.; F. W. Putnam, Reports upon Archaeological and Ethnological Collections from vicinity of Santa Barbara, Cal., etc.; Report upon U. S. Geogr. Surveys west of the 100th Meridian (G. M. Wheeler), 1879, VII, Archaeology. From more northern sections of the Pacific Coast may be mentioned specifically the shellmounds of Oregon (P. Schumacher, Bulletin, *l. c.*), of Vancouver, and of the mainland of British Columbia opposite (H. H. Bancroft, Native Races of the Pacific States, 1886, IV, p. 739), also those upon the Aleutian Islands, explored exhaustively by W. H. Dall (in U. S. Geogr. and Geol. Survey of the Rocky Mountain Region, J. W. Powell, Contributions to the North American Ethnology, 1877, I, p. 41 ff.). Together with those of California these shellmounds are an important counterpart to those found along the Atlantic coast, found from Nova Scotia to the Gulf of Mexico, as well as in the river valleys of nearly all the southern states (Charles C. Abbott, Primitive Industry, 1881, p. 439; Short, The North Americans of Antiquity, 1892, p. 106), and almost all of which have been carefully studied in some of their aspects, although not yet conclusively.

[6] Smithson. Reports, 1869, p. 36.

[7] Prehistoric races of the United States of America, 1874, p. 163.

[8] Journal of the Anthropological Inst. of Great Britain and Ireland, 1876, V, p. 489. The majority of these shellmounds have been graded down.

The Marquis de Nadaillac in his well known work mentions the shellmounds in the vicinity of San Francisco.[9] Moorehead in his work gives a few remarks on excavations in shellmounds of central California.

The Nature of the Excavations.

The work of exploration was commenced by Professor Merriam and the writer in February, 1902, toward the end of the rainy season, and was finished early in May. Captain Siebe, the proprietor of Shellmound Park, gave all possible assistance in the investigation. Owing to the presence of the circle of trees around the truncated top of the mound it was necessary to confine the excavations to a lateral section and a tunnel extending from it toward the center of the mound. However desirable a more extended section through the hill might have been, the results obtained in these partial excavations are as a whole similar to those which would have been obtained by a cut through the entire mound.

The western slope of the mound, facing the bay, was selected as the starting point for the operations. The entire work of excavation may in a chronological order be divided into the following four stages.

A. The first lateral cutting in the mound. This was made in the western foot of the mound, seven feet and a half above the level of the bay and at a distance of fifty feet from the plateau. The trench was two feet deep, eighteen feet long and six feet wide, its floor sloped towards the center of the mound.

B. Tunnel construction. The tunnel formed the underground continuation of the trench; it was the means of reaching the interior of the mound and down to its original base. Hence the floor of the tunnel was made to slope steeply inward. The tunnel was extended from the end of the trench *A* for forty-two feet into the interior of the mound, and at its terminal point it sank to two feet below the level of the bay. It was five feet wide and six and a half feet high. Several distinct strata were cut through by the tunnel section. Eleven feet of the length of the tunnel extended under the plateau of the mound. This was still

[9] Prehistoric America, ed. by W. H. Dall, 1885, p. 50.

sixty feet from the vertical center of the hill (pl. 4), but the observations made in this interior part of the mound were of a relatively greater value than those of the outer zone. Many difficulties were met during the construction of the tunnel, among which the porosity of the soil was one of the worst. The tunnel was therefore timbered and its sides sheathed. Another difficulty was the ground water, of which there was often a very strong flow when digging in the lower part of the tunnel. According to the advance of the season, it was encountered at different depths, and it grew less with the approach of summer. A small hand pump was used to exhaust this water, but it barely answered the purpose, and it was often with great difficulty that the inrushing water could be mastered.

C. The upper vertical cut of the entire mound. In order to obtain a view of all the strata contained in the mound this section was undertaken. The lowest parts of the mound having been thoroughly explored by the construction of the tunnel, it was now sufficient to make the upper sectional cut only as deep as the roof of the tunnel, while its terminal point was fixed by the circle of trees on the summit of the mound. Its greatest length from the mouth of the tunnel was twenty-six feet. The sides of the cut were sloped in order to prevent the fall of loose soil and to avoid the cost of timbering. The length of this section at its lower end, near *b* (pl. 4), was reduced from 26 feet to 19 feet, and the width to 10 feet along the entire foot of the trench from a^{9a} to *b*. In pl. 5 there is shown the first cut into the mound, before it had been made wider by five feet throughout its length. In making this cut the earth was removed stratum by stratum. For want of other marks of division, the dividing lines of the various strata (I to VII) were chosen arbitrarily from the several visible lines of structure, and they are marked in the diagram, pl. 4, by asterisks. In order to obtain a uniform classification of the contents of the mound it was thought necessary to introduce the same lines of division in the sectional diagram of the tunnel; objects found there had been marked previously by the distance of their position from the mouth of the tunnel and their relative height.

[9a] *a* seems to have been situated at the intersection of the dotted lines separating divisions *A*, *B*, *C*, pl. 4, fig. 2.—Editor.

These strata in conformity with the numbering of the upper ones were marked as numbers VII to X.

D. A series of pits was dug from the foot of the tunnel out to the bay shore. The pits were made in order to ascertain the general outline of the base of the mound under the cuts already made, as well as under the unexcavated portion of the mound farther out toward its margin. The pits are marked as *h* in the interior of the mound, and as *i, k, l, m,* toward its periphery. The two pits *n* and *o*[9b] are situated on the outside of the superficial foot of the mound, at a distance of 35 feet and 67 feet from the nearest pit, *m*. It was here seen that the terminal point of the foot of the mound lay between the pits *n* and *o,* the pit near *n* showing only the debris of the shellmound, while that near *o* revealed nothing of it. These two pits were connected by a trench, which gave an exceedingly interesting section of the margin of the mound.

The Base of the Mound.

The mound consists mainly of a mass of broken or entire shells, ashes, bits of charcoal, and some artifacts. This mass extends far above the surface of the surrounding land and ends two and a half feet below the level of the ground water and two feet below the general tide level of the bay, and rests immediately upon a sharply defined yellowish alluvial clay stratum. There is no indication of a rocky elevation which might have served as an inducement for the original settlement, and would have helped to raise the mound to its present height. Some of the charcoal and small boulders brought here by man rest upon the clay soil. A slight discoloration of the upper line of the clay stratum may have been caused by a transitory plant growth during some early period, while there is no indication of a crust of good soil which would be a sign of a longer period of vegetable growth upon it.

The base of the mound is horizontal according to all indications gained between pits *h* and *m*. A slight variation of the level of the ground near *h* of but a few inches does not materially change this level. Between *m* and *n*, however, the original

[9b] Pit *o* referred to in the text seems to be represented in pl. 4, fig. 1, by the west end of the cut extending from *n* to *l*.—Editor.

soil lies one foot and seven inches lower for a distance of thirty-five feet, and from *n* to *o* the level drops a foot lower. The mound was originally founded upon a site rising two feet above the adjacent ground on its western side. A gravel stratum of 8 inches in thickness near *o*, and of 4 inches near *p*, but disappearing towards *n*, covered the clay which originally sloped to the west. This gravel stratum was examined by Professor Lawson and considered to be probably a fresh-water deposit and not a deposit formed in the bay, as the gravel is more or less angular instead of much water-worn. The mound terminates near *p*, 177 feet from its center, where it runs to a point between layers of clay, which are above and below it (pl. 4, fig. 1). It rises again toward the outside for the last 17 feet measured from the depression *n*, the difference being one and one-quarter feet, thus varying from the rest of the base which inclines to the west. A stratum of ferruginous clay, the same as that underlying the base of the mound, is here inserted between the gravel stratum and the characteristic mixture of which the mound is composed, and covers it up even with the present surface of the soil. This raises the actual height of the shellmound from 27 feet to 32 feet and the actual diameter to at least 310 feet instead of 270 feet. The volume of the mound, measured as a truncated cone, may be estimated as being 55,000 cubic yards, or about 39,000 cubic meters.[10]

[10] The shellmounds in the vicinity of the bay differ considerably in shape and size. The majority appear as extended plateaus 10 to 12 feet in height, others appear as slight undulations of the ground about five feet in height. The truncated conical form is found more rarely; the mound at Ellis Landing near Point Richmond approaches it somewhat in its proportions. Many of these mounds cover acres of ground, *e.g.*, the mounds of Alameda, of Sausalito, of Sierra Point, of West Berkeley (in its older form, now much changed). In tropical regions many shellmounds are said to reach a height of 100 feet or more; this is known with certainty of some in Brazil (cf. Nadaillac, *l. c.*, p. 54), and also of two near the dried-up mouth of the Ica river in Peru. Shellmounds as a rule are much smaller. On the Atlantic coast near Smyrna a shellmound is said to be thirty feet high (Short, *l. c.*, p. 107), but the majority of these mounds are less than four feet high (cf. Wyman, Amer. Naturalist, 1868, I, p. 56 ff., and Abbott, *l. c.*, p. 440), while many of them extend over areas of more than two or three acres. A shellmound near the mouth of the Altamaha river in Florida is estimated as having a size of over 80,000 cubic yards (Smithson. Rep., 1866, p. 358). The shellmounds of Denmark are only from 3 feet to 10 feet high, although more than a thousand feet long (Ranke, Der Mensch, II, p. 552). Southern California shellmounds generally are from 4 feet to 5 feet high (P. Schumacher, Bull., *l. c.*, p. 38; and Smithson. Rep., 1874 ,p. 337, etc.). The same is the case with those mounds on the Aleutian Islands explored by W. J. Dall. In Oregon there are some of at least 8 feet in height (cf. Schumacher, *l. c.*, p. 29).

From what we know of the situation it is obvious that the mound was founded upon firm though still somewhat marshy land, near the bay shore and close to the creek. The latter was the occasion of its location[11] at this place. The ground must have been dry, since a gently rising slope was selected. The soil was alluvial and relatively new, since it has no overlying cover of good earth, yet it must have been dry long enough to allow a thin growth of vegetation to cover it, causing the slight gray discoloration of this stratum.

The situation of the base of the mound two feet below the water level cannot be explained on the assumption that refuse from a pile dwelling had been the first cause of its formation. This theory would presuppose modes of living to be followed by the Indians of this coast for which there is no parallel elsewhere, and which are not borne out by other evidence obtained in the study of the mound. If the mound has not risen from the water, then the former land surface must have sunk. The mound could not possibly have sunk below the water level from its own weight, for the original ground underneath it is still several feet higher than that to the west, for instance, near *n*, and sections of the base upon which the full weight of the mound rested, such as near *h*, are on the same level with others over which the mound rose only 14 feet. Since the sinking of the mound has not been brought about by local causes, it must have been caused by a general subsidence of this coast region. Similar subsidences of the coast, due probably to sliding motions, are frequent phenomena on alluvial coasts.[12] Evidences of this are furnished apparently by the

[11] Shellmounds in the bay region are mostly in localities where there is fresh water, a creek or a spring, generally the former. W. H. Dall (Contributions, p. 34) observes that for the formation of shellmounds on the Aleutian Islands two conditions are necessary, as a rule: running water or a spring, and a site suitable for boat landing; one or the other of these conditions lacking, no shellmounds are to be found. In Oregon the shellmounds are generally to be found near a creek (cf. Schumacher, *l. c.*, p. 28). The same rule probably governs the shellmounds of the East. D. G. Brinton found shellmounds in Florida generally near running water (Smithson. Rep., 1866, p. 356), but he supposes as the cause of this the greater abundance of shells near the mouths of rivers, while it is certain that the presence of drinking water was the main attraction.

[12] Parts of the eastern coast of the United States are sinking. Several shellmounds on the Jersey coast are being washed away at present (cf. Abbott, *l. c.*, p. 448 ff.). The same may be observed with the shellmounds near Ellis Landing on the Bay of San Francisco.

shores of San Francisco Bay.[13] The ground under the mound having a slope of two feet, it may be assumed that the original foundation of the base was at least one foot above tide level. Accordingly the coast must have sunk three feet since the formation of this mound.[14] This sinkage was leveled up again to its former height by later alluvial deposits, in consequence of which the originally dry base of the mound is now situated two feet below the level of the bay, while the surrounding flats are three feet above it.

It is to be noted that the younger alluvial deposit, near *o* (pl. 4) has a thickness of six feet.

Samples of soil taken from various parts of the clay stratum underlying the base of the mound were subjected by Professor W. A. Setchell to microscopical examinations, but no Diatoms were found in any of them. Hence those strata were probably formed of alluvial deposits of the creek, as Professor Lawson had at first suggested, and not of deposits of the bay. This finding is entirely in accordance with the origin of the gravel stratum as above stated.

The slope of the mound was an obstacle to the course of the creek when it became swollen. In the natural course of things it deposited a bar near the foot of the mound, which, when the edge of the latter gradually extended, grew out over this new obstacle. The creek in the same manner continued to heap up alluvial deposits against the latter. The horizontal growth of the mound and the vertical growth of the surrounding land took place simultaneously. This was the cause of the brim-like upward curve of the edge of the mound as seen in the cross section (pl. 4). While the mound increased about seventeen feet in its periphery, the vertical alluvial accumulation was about one and one-half feet. Hence the base of the mound peripherally increased one foot while the ground grew one inch, showing that the alluvial growth of the soil was much slower than the peripheral growth of the

[13] Near the mouth of the valley of San Rafael a small hill rises from the bay, the isolation of which from the mainland may be explained in this way.

[14] Between the shellmounds of Emeryville and West Berkeley the shore for a long stretch forms a steep bank up to twelve feet high, and broken down by the water of the bay. Possibly the coast at this point formed a promontory on the two sides of which these shellmounds were originally founded, as in sheltered bays, similar to other mounds of this region.

mound. About 310 cubic yards or 240 cubic meters produce a growth of one foot in a mound 9 feet high and about 300 feet in diameter at the base. If the peripheral growth of the mound had continued with the growth of the soil, the foot of the mound would have spread out so that the outer edge would rest in the highest or surface layer of the present alluvium. The wedge-like margin situated between alluvial strata is, however, proof that its peripheral growth ceased a long time before the termination of the alluvial accumulation in this region, as a result of which the alluvium has spread itself over the foot of the mound. The alluvial deposit above the wedged-in margin of the mound (at *p*) being 3 feet 8 inches in thickness, and the alluvium deposited underneath it from the beginning of the formation of the mound measuring only 1½ feet, and assuming the increase to have been absolutely uniform, a period two and a half times as long has passed since the ceasing of its peripheral growth, as had been necessary for a peripheral growth of 17 feet on each side. The cessation of this peripheral growth of the mound, however, is not identical with the cessation of its growth altogether. It took place apparently when the mound began to grow more acutely conical in shape, whereby it increased to twice its former volume. Assuming that the mound was abandoned 100 years before the end of the alluvial growth of the land in the vicinity, then according to formula

$$100 \times \tfrac{2}{3} f = 2\tfrac{1}{2} \times \tfrac{1}{3} f$$

it might be concluded that the mound was probably 600 years old before it was abandoned.[15] Several numerical values upon which the formula is based are unfortunately so uncertain that the result may not be considered as more than suggestive of the possible age.

The sinking of the coast and the alluvial increase of the ground since the first settlement of the mussel-eaters would in themselves give an adequate measure for an estimate of the age of the mound if the measures upon which both depend were not also unknown; according to Professor Lawson, this probably occu-

[15] In that case the sinkage would have amounted to about 6 inches, the alluvial increase to about 9 to 10 inches in a century.

pied centuries at least.[16] At any rate, such observations as have been made furnish good reasons for believing that the founding of a settlement and the beginning of the heaping up of the mound occurred at a remote date.

The Internal Structure of the Mound.

The principal constituents of the mound are the shells. These have nearly all crumbled into small fragments and are slightly mixed with soil, which when damp gives the entire mass the appearance of pure soil. When this is flooded with water the washing away of the sand produces no noticeable change in its volume. This mass has mingled with it bits of charcoal, bones of animals, ashes or cinders, and stones averaging about the size of one's fist and blackened by fire.[17] Marks of stratification may be traced through almost the entire mound. Plate 5, representing a photographic view of the excavation, shows the stratification planes in the walls quite distinctly. The strata consist of compact masses of more or less fragmentary shells, or of beds of ashes or cinders. In many cases the latter seem to extend through the entire mound. They are sometimes not thicker than a sheet of heavy paper, but show the general direction of the bedding planes, and form a clear contrast with the homogeneous, dark mass of broken shells.[18] These planes become somewhat less distinct in the deeper strata.[19] As in other shellmounds,[20] there were observed certain rounded masses of shells intersecting the lines of stratification. These are

[16] The rapidity of the sinkage of alluvial coasts varies greatly owing to local conditions. For the Atlantic Coast the rate of sinkage is 2 feet per century (cf. Abbott, *l. c.*, p. 449). Applying this same rate to the eastern coast of the Bay, we would arrive at the absurd result that the shellmound of Emeryville had begun to form in 1750, while that date was presumably the end of its occupied state.

[17] The descriptions of nearly all the shellmounds explored in other parts of the world tally exactly with this one; cf. Ranke, *l. c.*, II, p. 532, for the Danish Kjökkenmöddinger; Schumacher, on the general similarity of shellmounds of the Pacific Coast with the mounds in Denmark, Smithson. Rep., 1874, p. 355, etc.

[18] Although no shellmound is free from stratification marks, owing to the gradual growth of the strata, Brinton maintains that this is the case with shellmounds on the Atlantic Coast (Smithson. Rep., 1866, p. 356).

[19] Compare the interesting observations of Wyman (Amer. Naturalist, I, p. 571) concerning shellmounds of New England, that there the shells of the lowest stratum were softer and more crumbled than those of the upper strata.

[20] Cf. Wyman, *l. c.*, p. 365, on a shellmound in the vicinity of Portland, Me.

caused by holes, made by moles or other burrowing animals, being afterward refilled with shells.[21]

In some shellmounds in other regions strata of earth and sand were found between the shell layers. These give evidence of a temporary evacuation of the shellmound. No evidence of this character was obtained in the study of the Emeryville mound, where the only occurrence of a natural vegetable soil is the surface cover of 1 to 2 inches in thickness, which has formed since the mound was finally abandoned.[22] It is possible that slight differences in the state of preservation of the shell deposits which now mark the strata lines may have been caused by differences in the length of time of occupation. Other explanations might, however, be offered.

The lines of stratification mark clearly the gradual development of the strata of the mound from the base until the present truncated cone was formed. It is apparent that two different principles governed the growth of the mound. At certain periods it tended to take on a shallow plateau form. At other times a conical shape developed without the corresponding increase around the base. According to the first principle the mound grew in the form of a plateau to a height of from 9 to 10 feet. Near *C* in pl. 4 the edge of the plateau still seems to be traceable, from which point the strata inclined downward. At that period the mound resembled in its proportions the old Indian camping places of the interior valley, some of which are still occupied; or some of the shellmounds along the Bay which have been abandoned at some earlier period. The undulating lines of the strata, such as seen near *f* and *g*, suggest irregularities of the old plateau surface, similar to those which may be observed in the surfaces of camp locations of the interior, which have been abandoned for decades. The hollows from 20 to 40 feet in length

[21] Similar holes made by moles may be observed occasionally upon old shellmounds along the Bay, which if they had been refilled with shells might also have assumed a rounded form. In such a manner may be explained the finding of a modern steel knife, with the wooden parts still well preserved, in one of the strata of the shellmound of West Berkeley in a place to all appearances undisturbed.

[22] Cf. also Wyman, *l. c.*, p. 571. The absence of true soil from the interior of the mound is proof that at no time was the mound abandoned by its occupants long enough to allow of the formation of such a stratum.

mark the sites of former sweat-houses or council-halls; these curves, such as that from *f* to *g*, may have a similar origin.[23]

The manner in which the mound was occupied for habitation varied in the upper strata. With the growth of the mound the diameter of the plateau decreased instead of expanding. From line *b* upward the strata incline obliquely toward the sides. This change in the manner of forming the mound signifies a change in the character of its occupants. It would be interesting to determine, if possible, the exact line where these two types of growth have met. It might have been about 12 feet above the base, so that the mound grew in the shape of a shallow plateau as far as the middle of stratum V in pl. 4, and that it changed after this period to its conical form.

Constituents of the Mound.

Shells.—The shell layers of the mound are composed principally of the following species:

Oysters, *Ostrea lurida.*
Mussel shells, *Mytilus edulis* and *Mytilus californianus.*
Clams, *Macoma edulis* and *Macoma nasuta.*

Many other kinds of shells, including the following species, were found scattered through the mound:

Purpura crispata and *canaliculata.*
Cerithidea californica.
Helix, two species indet.
Cardium corbis.
Standella, sp.
Tapes staminea.

Of these last species, the cockle, *Cardium corbis,* and the clam, *Tapes staminea,* occur quite frequently.[24] All of these were used as food by the occupants of the mound. The various species of *Helix* were probably also used, as they were in more recent times eaten by the California Indians.[25] It may be, however, that this species lived on the mound.

[23] Somewhat smaller but quite similar hollows are still preserved upon the surface of the shellmound of Ellis Landing, and are doubtless sites of houses of that nature.

[24] Eight-tenths of all the shells found in the Oregon shellmounds belong to the species of *Mytilus californianus, Tapes staminea, Cardium nuttalii,* and *Purpura lactuca* (Schumacher, Smithson. Rep., 1874, p. 335).

[25] As by the Minooks and the Nishinams (Powers, *l. c.,* pp. 348 and 430); and certainly the custom was a very general one.

The state of preservation of the shells is proportional to their natural hardness. Hence the shells of the Macomas are the most conspicuous, those of the mussels, as the most perishable, are the least noticeable ones in the mound. The relative frequency of occurrence in the case of the three most important species depends on different circumstances.

The lower and the upper strata of this mound are composed of the same varieties of shells, in which point it is different from many shellmounds in other regions. It is, however, true that oyster shells predominate in the lower strata, while *Macoma* shells are more numerous in the upper ones.[26]

Visiting the different shellmounds in the vicinity of the Bay, one finds a general similarity in the kinds of shells composing them. Rarely one or another variety of shell, the *Macoma* or the cockle, or some other, is found to predominate. This general homogeneity of composition in the shellmounds around the Bay, and the small differences in the amount of any particular species, indicates as a whole the general similarity of the shell fauna at many points about the Bay during the period of occupation of the mounds.

The Indian camping grounds in the interior, although quite similar in form and origin to the shellmounds on the coast, when opened generally present a great difference in appearance. Traces of shells are almost unnoticed from the outside, yet large quantities supplied as food by the rivers of the interior are doubtless to be found in them. These shells have been found during excavations, or their use has been confirmed by persons who observed the mode of living of the Indians of these regions. The Indians also obtained salt-water mussels by trade, even in quite recent times. From the fact that shells are not in evidence on the surface of the camp grounds, one must conclude that their use diminished.

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[26] We were not so fortunate as was W. H. Dall in the shellmounds of the Aleutian Islands in being able to make "a tolerably uniform division" of the layers in the mound according to the various foods used. (These layers were: "1, Echinus layer; 2, fishbone layer; 3, hunting layer." Contributions to North American Ethnology, I, p. 49.) The shellmound of Emeryville presents a much greater similarity in the kinds of food used during the different periods of its occupancy.

Bones.—Bones of vertebrates are also found in most of the shellmounds. These together with the shells represent the debris of their kitchens. No other shellmound has been seen where so large a quantity of bones was observed as in that at Emeryville. Bones of land and sea mammals, of birds, and of fishes were found in abundance throughout the mound, and fairly evenly distributed in the strata. This fact is the more remarkable since the shellmound at West Berkeley, scarcely two miles distant, does not yield nearly such quantities of bone as this one. The occupants of the mound at Emeryville at all periods were huntsmen to a great degree, besides being fishermen; those of the mound at West Berkeley seem to have depended largely upon fishing; hence the stone sinkers were far more numerous in that mound than at Emeryville.

So far the fauna of only the lowest strata up to 3 feet above the base have been studied. The following species obtained in this horizon were determined by Dr. W. J. Sinclair.

Deer, *Cervus* sp.
Elk, *Cervus canadensis.*
Sea-otter, *Enhydrus lutris.*
Beaver, *Castor canadensis.*[27]
Squirrel, *Spermophilus* sp.
Rabbit, *Lepus* sp.
Gopher, *Thomomys talpoides.*
Raccoon, *Procyon lotor.*
Wild cat, *Lynx* sp.
Wolf, *Canis* sp.
Bear, *Ursus* sp.
Dog, *Canis familiaris.*[28] (*?*)
Seal, *Phoca* sp.
Sea-lion.
Whale.
Porpoise?
Canvasback Duck, *Aythya vallisneria.*
Goose?
Cormorant, *Phlacocorax* sp.
Turtle.
Skates, Thornbacks, and other fish.

[27] Extinct in California, and in fact south of Washington; J. Wyman found the remains of elk, wild turkey, and large auk in the shellmounds of New England. The elk, though still in existence, is no longer to be found east of the Allegheny Mountains; the wild turkey is still in existence, but is not to be found in New England, while the auk lives only in the Arctic regions, or at least not farther south than the northern part of Newfoundland (Amer. Naturalist, I, p. 572).

[28] Also found in the shellmounds of New England.

No traces of cannibalism have been detected. Most of the hollow bones of larger mammals, and even the smaller bones of the foot, were found to have been split to get at the marrow.[29]

Fireplaces.—These were generally known by beds several feet in length consisting of charcoal and yellowish ashes. They occurred in many spots throughout the mound. Numberless scattered bits of charcoal[30] and pebbles, mostly about the size of one's fist and blackened by fire, were further evidences of the continuous use of fire in the preparation of food. In no instance were there any stones set in rows for fireplaces, such as have been observed elsewhere, as in a shellmound near Sierra Point, where stones are plentiful.[31] A very peculiar feature of this mound is a yellowish layer of ashes comprising the entire depth of stratum II in pl. IV, and tapering towards the edge of the mound. Above it lies only the uppermost stratum (I), that of vegetable soil. Though calcined shells[32] occurred elsewhere in the mound, they were especially numerous in this ash stratum, and in some spots all shells were calcined. The origin of this ash stratum will be explained later. A similar bed is to be seen in a central layer of the shellmound at West Berkeley, and another one of similar thickness but shorter in a mound near Sausalito.

Human Remains and Relics.—A large part of the Emeryville mound consists of remains which have been deposited here by man. Among these are mollusean shells with bones of fish and mammals, used as articles of food. In the narrower sense the human relics consist of the bones of man, graves, and artifacts, which are all found in greater or less abundance throughout the whole thickness of the mound. Actual human bones were not found to be common in this part of the mound except in stratum II, and in the graves of stratum VII. The artifacts obtained

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[29] Cf. for shellmounds in Denmark: Ranke, *l. c.*, II, p. 532, for those of the Atlantic Coast, Wyman, *l. c.*, p. 575 (New England) and Abbott, *l. c.*, p. 442 (New York).

[30] Analogous is the statement of Wyman, *l. c.*, p. 564, about the shellmounds of New England.

[31] Cf. also Hellwald, Der vorgeschichtliche Mensch, p. 449, on the Kjökkenmöddinger of Denmark.

[32] Nadaillac, *l. c.*, p. 50, states from uncertain authority that a shellmound near San Pablo was said to consist of calcined shells exclusively, which is certainly an exaggeration.

were only those of very resistant material, such as stone or shell. All other kinds, such as textiles of plant fibre, baskets, and implements of wood, which doubtless have also existed, had disappeared. The more resistant artifacts were distributed throughout all layers of the mound.[33]

About 200 cubic meters of earth were removed and sifted during the excavations, and yielded 600 artifacts of various kinds, averaging three specimens to one cubic meter. The volume of the whole mound we computed to be about 39,000 cubic meters, and it may be assumed that by excavating the entire mound the yield would be about 100,000 specimens, which indicates that many generations must have lived here to deposit such a large number of objects of imperishable material alone.[34]

The same computation was applied to each separate layer in the mound, and it was shown that the yield differed according to the section and the stratum explored. The open cut *A* yielded one specimen to .75 cb. m., and the tunnel *B* and the pits *h* to *m*, six per cb. m. Section *C* yielded three artifacts to one cb. m. This computation shows that sections nearer the center of the mound yielded the greater number, those toward the edge a smaller number. It also appears that the lower strata contained a larger percentage of artifacts than the upper ones. If, however, the number of flaked chert fragments were subtracted from the yield of the lower strata, their percentage would be much the same as that of the higher layers. The following are the contents of the various strata:

Stratum I had 20 artifacts per 15½ cb. m. = 1.3 per cb. m.
Stratum II, 30 cb. m—133 objects = 4.4 per cb. m.

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[33] It is alleged that there are shellmounds in the East which contain no implements at all, and have been used for the gathering of mussels only, and not as dwelling places (Abbott, p. 447, accord. to Charles A. Woodley). Equally uncertain seems to be the distinction made by Schumacher between shellmounds yielding few artifacts and those containing a larger number, as representing a place for temporary or permanent habitation. Similarly dubious is that classification which considers the piling up of shells in various separate heaps as proof of permanent abode and that of single mounds for the use only as temporary stopping places (Smithson. Rep., 1874, pp. 337 to 338).

[34] W. J. Dall (contrib. *l. c.*, I, p. 47) states that during his excavations of the shellmounds of the Aleutian Islands he found on the average one object in one-half ton of earth. This would be 2.63 objects to one cb. m. The yield of the Emeryville shellmound is three objects to one cb. m.

Stratum III, 20⅔ cb. m.—27 objects = 1.16 per cb. m.
Stratum IV, 11¾ cb. m.—41 objects = 3.5 per cb. m.
Stratum V, 9⅔ cb. m.—34 objects = 3.5 per cb. m.
Stratum VI, 4⅕ cb. m.—9 objects = 2.1 per cb. m.
Stratum VII, 2⅘ cb. m.—10 objects = 3.5 per cb. m.

The specimens contained in the graves in strata VI and VII were not counted in with the rest. This comparison shows mainly that stratum II is the richest in implements. The connection of this fact with the preponderance of ashes will be pointed out later.

Burials.

Shellmounds originate on the accumulated refuse deposited by people who have lived in the place when the heap has formed, and the mounds may therefore be regarded as sites for dwelling places, or abodes for the living, and not as mounds set aside as burial grounds by people living elsewhere in the vicinity. Whenever these mounds were used for burials it was not done in spite of their being dwelling places, but rather because they were such.[35]

Many tribes of a low grade of civilization follow the custom of burying their dead underneath their feet in the ground upon which they live, to protect the graves of their dead against being disturbed and also to enjoy the protection of the spirits of the departed against their enemies. Wherever graves are found in shellmounds, in all parts of the world, their presence is generally to be explained in this way.[36]

Ten graves containing skeletons were found during the excavations. They were found only in the middle layers of the mound in a zone extending from stratum VI to stratum VIII. The two lowest layers and the five upper ones contained no evidence of interment, indicating that the custom of burial underneath the

[35] See P. Schumacher, Bull. *l. c.*, p. 38, for burials in the mounds on the Island of San Miguel.

[36] Virchow found them in the Spanish shellmounds (Ranke, *l. c.*, II, p. 533), while in those of Denmark they are absent. Schumacher (Smiths. Rep., 1874, p. 337) states that he observed shellmounds in Southern California which had been temporary abodes only and were devoid of graves; while D. G. Brinton asserts that in Florida graves occurred in natural shellmounds, while artificial shellmounds were free of them (*l. c.*, 1866, p. 357). Such general statements cannot be accepted unless they are supported by observations over larger fields than these.

dwelling places was observed in one period only. We have no evidence concerning the location of the burials previous to that period or subsequent to it. A burial site slightly elevated above the plain was unearthed some years ago under a shellmound near the principal mound in Emeryville, but as this probably dated from the same period as the graves in the shellmound no light is thrown upon the question.

In the upper strata of the mound there is, however, furnished evidence of a different manner of disposing of the dead, which was observed during the period of the deposition of strata II, III, and IV. During the period represented by strata VI to VIII the dead were buried in the ground. It has already been shown that stratum II consists mainly of ashes and calcined shells, which cannot be regarded as kitchen-midden deposit or as the remains of fireplaces, the latter forming an inconspicuous part of the stratum. Another characteristic feature of this layer is the high percentage of calcined bone implements found there. Very common among them are awls, of which stratum II contained 44 calcined specimens, or 72 per cent. of the whole number. In the other layers a much smaller number has been found, but the percentage of calcined specimens is high. The supposition that these were accidentally burned cannot be considered an adequate explanation, but the fact that a number of human bones were found at the same place in the strata gives weight to the theory that during the deposition of the upper beds the inhabitants of this region practiced cremation of their dead, a custom common among the California tribes of today. Then as now they were accustomed to burn all personal belongings with the body.[37] This accounts for the large number of calcined bone objects and shells in stratum II. Doubtless a large number of shell-fish were thrown into the fire as food for the departed on their long journey into the next world.

Doubtless the practice of cremation was not confined alone to the period of stratum II. The percentage of calcined awls in other strata than this suggests that the builders during the ac-

[37] H. C. Yarrow, Introduction to the mortuary customs among the North American Indians, 1880, p. 58, points out that this custom was general among those Indians who cremated their dead.

cumulation of stratum I, and probably also of III and IV and parts of V, practiced this custom, but to a less extent than in the period of stratum II, or mainly at other places than the mound.

Eight of the ten graves containing skeletons lay close together in the narrow space of the middle section of the excavation. Four were found in strata VI and VII of the upper cut *C*. Four of the graves were those of children, lying at different depths in the line of the tunnel. Two other graves were isolated from the others, lying in the edge of the mound. None of the burials were less than nine feet below the present surface. The lowest grave, No. 10 (pl. IV, fig. 2), was 21 feet below the surface. In accordance with the stratification lines of the mound, graves 1 and 2, as well as 6, 8, and 9, may be considered as belonging to the period of strata VII and VII*a*. The eight graves which lay close together in the middle of the main excavation were distributed over a space of about 90 square feet. The vertical distance from the uppermost to the lowest of these was nine feet. As the tunnel inclines toward the center of the mound it is not certain whether the cemetery extended through the entire mound or was only around the margin of a settlement on the summit of the mound at the time when it was in use. From the depths at which the different graves were found, varying about nine feet, it is clear that they were not constructed within a short period, but that long periods intervened, during which the mound grew very considerably through the deposition of refuse. P. Schumacher explored the graves of Oregon, which lay at a depth of from 1½ to 2½ feet below the surface, and probably the tribes of the Pacific Coast buried their dead in comparatively shallow graves.[38] In the case of a child's grave (No. 9, pl. 4, fig. 2) it was seen by the stratification lines that it was not made deeper than 1½ feet below the surface. Assuming this as being the general depth of the graves throughout the mound, then the graves varying between 2½ and 12½ feet above the base of the mound were dug at periods when the entire height of the mound was about 5 to 14 feet, hence the period of these burials would have to be placed

[38] Bulletin U. S. Geol. and Geogr. Survey, III, p. 34. In other places shellmound graves lie deeper; thus sometimes three to six feet on the Island of San Miguel (P. Schumacher, Bull. *l. c.*, p. 38).

entirely during the time of the earlier plateau-like growth of the mound. This period of burial is very closely followed by that of cremation, the two possibly overlapping.

The preparation of the graves was not elaborate. A simple pit sufficed. It was made large enough to place the body in it with the knees drawn up. The sides of the grave were left bare. If a covering existed originally it must have been of perishable materials, for none have been found in excavation. The bottom of the grave, however, was prepared somewhat like a bed. A layer of charcoal from one-half inch to one inch thick is found at the very bottom, above that another layer of like thickness of iron oxide. Upon this the body was laid on its side. It is evident that the body was buried with its clothing and personal ornaments, in exceptional cases with utensils or implements only. The body was tightly bound at the knees before burial. Owing to climatic conditions, causing excessive moisture in the strata, the greater part of the material buried with the corpse has decayed and disappeared. Five of the ten graves were entirely lacking in implements or other artifacts.

Before burial the body was entirely covered with the red earth mentioned above. This settled down upon the bones after decomposition and is still adhering to them in some cases like a thick crust. The hands were placed on the body in different ways. In several instances the left hand rested upon the knees, while the other was raised to the mouth or to the crown of the head. The corpse is usually laid upon the right side, generally facing northeast. Associated with a number of skeletons were a variety of interesting ornaments, including beads made from shells of *Olivella* and other molluscs and from sections of bird bones strung together. With skeleton No. 4 were associated a large number of perforated mica flakes. The flakes of mica may originally have been fastened to a garment which shrouded the dead, and when this decayed in the earth the flakes remained there about the body. Beads of bird bone were found in the mouth also, but their presence there might be explained by the settling of the skull in the earth. Mica was much used by the Indians for ornamentation. It has been observed in Peru in a number of cases in the vicinity of graves, but circumstances did not show whether

its presence there was purely accidental or not. In the mounds of the middle west of the United States there have sometimes been found ornaments of thin plates of mica of round or oval form, provided with holes to fasten them to the clothing.[39] Similar objects were found in West Virginia and elsewhere. Pieces of mica 2 or 3 inches in size are reported to have been found in mounds or in places suggestive of their use for religious purposes.[40] Beads like the above mentioned from California, both from graves and from living Indians, were pictured by Holmes.[41] With burial six was a bone ring set with shell beads fastened on with asphalt. In burial seven were numerous bone rings similarly decorated with shell beads. Also in burial seven was found a large quartz crystal. One end of the crystal is preserved unbroken. The other end is capped with asphaltum in which numerous small shell beads are set. Quartz crystals have been found elsewhere in California in graves.[42] The above mentioned crystal, however, reminds us most strongly of a number of crystals one foot in length and of the thickness of one's arm, found during the excavation of the western wall of the Temple of the Moon at Moche (Trujillo), in Peru, now in the collection of the University of California. These, too, had the coating of red coloring earth, the same as the object shown on pl. 11, fig. 9, and were found under peculiar conditions pointing strongly to their religious significance.

Several peculiar bone implements were obtained in burial eight.

The mode of burial seen here resembles that observed elsewhere in the shellmounds of California, for example, near San Luis Obispo, and that of other regions on the Pacific Coast (Oregon), and it is still followed among the California Indian tribes. The burial of the corpse with its knees drawn up has also been observed in Southern California[43] and Oregon.[44] From the latter

[39] Charles Rau, Ancient Aboriginal Trade in North America, Smithson. Rep., 1872, p. 361 (from G. Squier).

[40] *l. c.*, p. 360.

[41] Art in Shell, Second Annual Report of the Bureau of Ethnology, 1880 to 1881, pl. XXIII, fig. 6.

[42] P. Schumacher, Smithson. Rep., 1874, p. 349.

[43] Central California, cf. also Moorehead, *l. c.*, p. 259.

[44] P. Schumacher, Bull. *l. c.*, p. 34.

region also the varying positions in which the corpses face is confirmed by Schumacher.[45]

To the layer of charcoal and red iron oxide which generally formed the bed of the dead may be compared the "thick burned brick-like crusts" and the "thin light colored crusts" found by Schumacher in Southern California graves.[46] A large number of lumps of red coloring earth were found throughout the mound, some of these showing marks of scraping or cutting. In Southern California graves we find conditions resembling these almost identically.[47] Up to recent times the California Indians very generally painted their bodies, and there is undoubtedly a religious significance in this practice of daubing the corpses and associated objects with red coloring material, besides depositing them on red earth. The custom of putting red coloring matter on the body of the dead is found with many aboriginal tribes. So the Caribs in Jamaica[48] paint the entire body of the corpse. The Santees of South Carolina[49] painted face, neck, and hands of the corpse. The Dakotas[50] painted the face alone. In a number of Peruvian mummies the faces were painted red. Crania from ancient Peruvian graves that had been disturbed at some early time were also found covered with red paint.

The absence of implements is explained by Schumacher by the analogous custom of the lower Klamath tribes, where the implements are laid upon the grave instead of being buried with the dead.[51] This custom may have prevailed in this shellmound.

It was an unfortunate circumstance that the exploration in Emeryville occurred at a season of the year when the interior of the mound was still very damp from preceding rains. For this reason none of the skulls could be secured intact, and they will need to be carefully prepared before use can be made of them for

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[45] F. W. Putnam, Rep. upon U. S. Geogr. Surveys, *l. c.*, p. 30; Schumacher, Smithson. Rep., 1874, p. 341.

[46] Smithson. Rep., 1874, p. 342.

[47] Putnam, *l. c.*, p. 22; Schumacher, Smithson. Reports, 1874, p. 350.

[48] Yarrow, Introduction to the Study of Mortuary Customs among the North American Indians, 1880, p. 54.

[49] Schoolcraft, Archives of Aboriginal Knowledge, 1860, IV, p. 156.

[50] Yarrow, *l. c.*, p. 71.

[51] Bulletin *l. c.*, p. 34.

anthropological study. It may be noted that none of them show striking eccentricities of form.

Following is a detailed statement of the occurrence and the contents of each of the ten burials excavated.

No. 1, pl. IV, fig. 2, was found 9 feet below the present surface; it may be contemporaneous with the graves of stratum VII (as 6 and 9). The skeleton was that of an adult, drawn up in the usual manner. It was laid on its right side and was facing east. The left arm rested upon the knee, the right hand on the crown of the head, where also was found a cockleshell. The skeleton lay on a bed of red soil; the bones were slightly reddened. No associated objects.

No. 2. Skeleton of an adult, found at a depth of 9 feet in the outer part (*A*) of the excavation; neither red earth nor associated objects present. The burial dated probably from the same period as the preceding.

No. 3. Grave of a young person, about 15 years of age, in stratum VI. The skeleton was facing northwest. No artifacts or other associated objects.

N. 4. Grave of an adult, in stratum VI. The skeleton lay from east to west upon a double bed of charcoal and red earth. Interspersed in the soil were found a great quantity of flakes of mica 1 to 1¾ inches in diameter, rhomboidal, triangular, and irregular in shape, and each with a hole at one end (see pl. II, fig. 18); also a quantity of beads made of bird bones were found upon the cranium as if they had formed part of a net drawn over it; others lay along the sides of the head and along the temples.

No. 5. Skeleton of an adult lying from east to west and facing north. Stratum VI. The cranium shows a lupus-like mutilation of the nose (fig. 2). No ornaments.

No. 6. Grave of a child a little over a year old, found in the tunnel in stratum VII*a*, at a depth of 17 feet below the surface. It lay from north to south upon a bed of charcoal and red earth. Various ornaments and other articles were taken from this grave, all covered with red earth. A number of shell beads, both flat (cf. pl. 11, figs. 6*a* and 6*b*), and concave forms (pl. 11, figs. 5*a* and 5*b*) lay in rows from the neck down along the body, and were originally necklaces; two bored round pieces and two oblong ones

(pl. 11, figs. 1 and 2) of *Haliotis* shell had completed the necklace. An unusual object (pl. 11, fig. 8) found here was a flat ring three-eighths of an inch wide, three-sixteenths of an inch thick, neatly made of stone, both surfaces being decorated with a number of shell beads, originally 11 to 12 on each side, fastened with asphaltum. This object may have been a pendant, but doubtless it possessed talismanic virtues.

Shell beads like the larger convex ones of *Olivella* sp. have been pictured by Holmes as objects belonging to early and modern Indians of California. Possibly they also resemble the shell coin "Kolkol" of the modern Indians, which is made of *Olivella*

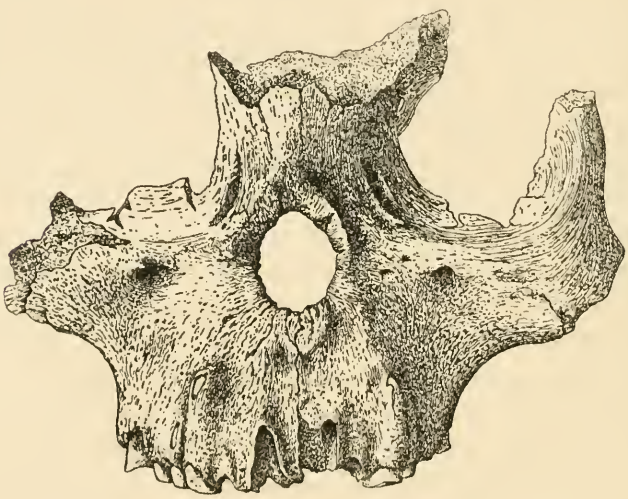

Fig. 2.* Skull showing lupus-like mutilation of the nose. × ½.

biplicata, according to Powers, and was strung in such a manner that the beads faced each other in pairs, but are not much in use in modern times.

A shell ring of similar proportions as above, but differing through its inferior material and the absence of decoration, has also been pictured by Holmes as coming from Illinois, and as being an ear ornament presumably, while the object described above could not have served that purpose.

* Fig. 1 has been omitted owing to double references in the manuscript.—Editor.

No. 7. Grave of a child about one year old, found in stratum VIII, about 21 feet below the surface of the mound. The body lay upon the usual bed of charcoal and of red earth and all the little bones were thickly covered with red coloring matter. The grave was as rich in artifacts as the preceding one. A number of small shell beads (as in pl. 11, fig. 6) were found near the wrist. The following objects were taken from the earth about the body:

Three oblong ornaments, bored, of *Haliotis* shell (pl. 11, fig. 1), a number of very small shells of *Olivella* sp. having bored ends, which fact shows that they were used as ornaments; 11 bead-like rings of bone, each being about one inch long and seven-sixteenths of an inch thick; each has a band of asphaltum in which three or four small shells were imbedded (pl. 11, figs. 10, 11). While these rings may have been mere ornaments, the following unusual object (pl. 11, fig. 9) taken from the same grave must without doubt have talismanic importance. It is a piece of quartz crystal $2\frac{15}{16}$ inches long and $1\frac{1}{2}$ inches thick, having perfect lateral edges and points; the broken base of the crystal is capped with asphaltum in which numerous small shell beads are set.

All these objects were thickly coated with red coloring matter. For the small ornamental *Olivella* shells compare similar ones from Santa Rosa Island, California, pictured by Holmes (l. c., fig. 7). The bone ring resembles the thick bead-like bone ring taken from another of the graves, stratum VII*a*, of the mound.

No. 8. Burial of an adult, in stratum VII, found above the tunnel. The body in the usual squatting position was placed from north to south, facing east, upon a bed of red earth and was itself colored red. This grave contained besides objects of personal adornment a number of bone implements. The former consisted of a number of beads made of bird bone (types similar to object pl. 11, figs. 15 to 17) and a like number of *Olivella* shells bored at the lower end (pl. 11, fig. 3); they were scattered in the earth about the body. One of the *Olivella* shells was perforated on its side (pl. 11, fig. 4). Several of the bone beads were connected in twos by thinner bones (pl. 11, fig. 15). It may be assumed that the bone beads and shells had been fastened to a garment that served as a shroud for the body but has now disappeared.

The bone implements taken from this grave have the shape of paper cutters; there are five in all, representing two distinct types. Three are made of a hard bone (pl. 8, fig. 4) and are imperfect at their upper ends; the form is that of a horn, the worn edges show their use as tools; the other two objects (pl. 8, fig. 5) are made of a much softer bone; they are unfinished at their lower ends. The two types are distinct, although it is difficult to compare them in their very imperfect condition. The upper end of the implement of the second type shows two hooked projections connected by an outward bending of their rims. They have each a hole on the lower edge of such a size as to admit a finger, to facilitate the handling of the tool. Neither of these types was met in other parts of the mound.

An *Olivella* shell with side perforation similar to that of plate 11, fig. 4, from a grave on Santa Rosa Island has been represented by Holmes.[52] Bone beads similar to that of figs. 16 and 17 on plate 11 were found in nearly all the strata of the mound; two of these are shown in figs. 13 and 14 of the same plate, the former, 1–8702, from stratum IV, the latter, 1–8743, from stratum V. It also has a remnant of a former axle-like connection with another bead as was shown in fig. 15 from stratum V. Bone beads have been widely used as objects of adornment by the California Indians, as is the case with many tribes in other parts of the world.[53] With the Yokuts bird bone pieces of 2½ inches in length at one time represented a value of 12½ cents.

No. 9. A child's grave, in stratum VII*a*, in the tunnel about 18 feet below the surface. The associated objects were convex shell beads (cf. pl. 11, figs. 5*a* and 5*b*) and a cockleshell upon the crown of the head (cf. grave No. 1).

No. 10. Grave of an infant with very delicate bones. It was found in the lowest part of section VIII, 23 feet below the surface.

Age of the Mound.

The shellmounds of the environs of San Francisco Bay are almost the only witnesses of a practically unknown period in the

[52] Art in Shell, pl. XXXII, fig. 2.

[53] W. H. Dall, for instance, found them among other places in shellmounds on the Aleutian Islands (Smithson. Contrib., 1878, No. 318, pl. 10, No. 17261.

early history of this region.[54] They appear to us at first investigation unintelligible, both as regards the beginning and the end of the period during which they served as human abodes. For a solution of the problem before us the most diverse kinds of investigations must be carried on, before the principal facts of this history can be clearly brought out.

Shellmounds can be found along almost all parts of the inhabited coast. In California as well as in other parts of the world they originate by the accumulation of remnants of food, especially the shells of the mollusca which are used as articles of diet. In the midst of the remnants of food cast aside by him, man clung to his place of abode, raising it more and more above the general level of the ground through the gradual accumulation of these materials. Hence these localities represent, in certain stages of human development, true but nevertheless low types of human dwelling places. The manner of procuring the essentials of life by collecting shells in itself indicates a low form of human existence. In all parts of the world, even today, people may be seen on the shore at low water gathering for food the shells uncovered by the retreating tide; and although under the changed conditions of life they raise no shellmounds, these people always belong to the lower classes of society, and lead in this manner a primitive as well as a simple life. Peoples depending for food upon collecting shells are usually not agriculturists, but fishermen, and perhaps hunters as a secondary occupation. Their implements are of the rudest kind, made of bone, stone, wood, and the like. Industries of a more highly developed kind, *e.g.*, the dressing of ore and working it up into various implements, remained unknown to them, except in perhaps a few instances.

Thus it seems natural to connect the origin of shellmounds in general with the work of prehistoric generations, *i.e.*, man of the stone age. The only condition necessary for their origin is, that the people who raised them lived somewhat close together and therefore possessed a certain social organization. For only in many centuries or even in tens of centuries could even large groups of men pile up such enormous quantities of kitchen debris

[54] Powers, *l. c.*, p. 375.

into hills which come to form prominent features of the landscape. Though little is definitely known, the beginnings of human social organization evidently reached back into Quaternary time, just as is the case with the beginnings of human ornamentation. There is therefore no good reason why the origin of the shellmounds could not date back to Quaternary time. In this connection mention must be made of the fact that, according to Cook,[55] stone implements of argillite, which would consequently be attributed to the palaeolithic man, were found in a shellmound of New Jersey. The well known shellmounds of Denmark, the so-called "Kjoekkenmoeddings" (*i.e.*, "Kitchen debris"), which first attracted the attention of scientists to the remnants left by prehistoric men, are not so old.[56] Nevertheless, it has been possible to prove by them that Denmark had at the time of their origin a flora considerably different from that of the present, and that the Auerhahn, too, lived there, which does not exist in Denmark to-day. J. Wyman, a very careful explorer of the shellmounds of New England, does not consider the Atlantic shellmounds of this continent as old as those of Denmark.[57] He seems to have taken this view because he met with no authentic proofs of a greater age. These were difficult to obtain. Yet he calls attention to the finding of traces of the auk, the wild turkey, and the elk in those shellmounds, *i.e.*, animals which no longer exist in the region of shellmounds investigated by him. According to him, their disappearance took place in historic times.

In determining the age of the Emeryville mound we note first the fact that no traces of typical Quaternary animals were found in it. It is interesting to find that this mound resembles those just mentioned in regard to the finding of traces of the beaver, an animal no longer met with in this region. It was found in one of the lower strata of the mound. How far it reaches upward cannot as yet be decided, since the large number of bones taken from the upper beds have not all been examined. Since the time that remains of this animal were deposited in the lower strata of

[55] Quoted by Abbott, *l. c.*

[56] Cf. J. Ranke, Der Mensch, II, p. 536. These shellmounds are placed in the earlier stone age of the current geologic periods.

[57] *l. c.*, p. 571.

the mound, the beaver has retreated from this region, in fact from the whole of California, in a northerly direction, possibly up to Washington. When it left this region is not known. We cannot, however, be certain that this retreat may not have commenced in recent times.

Another fact of importance in fixing the age of this mound is found in the apparent change of level of the strata upon which the original layers of the mound were placed. As nearly as can be determined, the original fundament upon which the mound stands has sunk at least three feet. The base of the mound, formerly probably one foot above the usual high water level[58] of the bay, lies at present two feet below. If the mound with its environs had not since grown above the level of the original floor, it would be inundated completely for several hours twice a day. The length of time required for such a subsidence we can of course not determine with any exactness, as no measure of subsidence is available. In all probability it is to be taken as an indication of considerable antiquity.

Further facts upon which an approximation of the age of the mound may be based are of a purely anthropological nature. Usually the early period in which man made use solely of flaked stone tools is contrasted with the later age when polished as well as chipped stone implements were used. In the very lowest stratum of the hill, almost down at the base, there were found stone implements of the well known palaeolithic turtle-back form. A pestle fragment which came from the lower stratum of the mound, though having a completely disintegrated exterior, seems to have originally been artificially rounded. A mortar fragment found low down may have originated from an implement which was formed, as is often the case, out of a common boulder. But before it broke from this object the mortar was deeply worn out, just as others that have come down to our times. Also, the deep concavity of its rims speaks for long continued wear. The next stratum (two to four feet above the base of the mound) yielded the fragment of a pestle of irregular, not rounded cross-section. Here a common oblong pebble may have been used as a pestle.

[58] On an average once in every 14 days the high tide reaches a higher mark, which, however, is not considered here.

Besides these, the two lower strata furnished only an oval, flattened pebble, probably used as a hammer, the only one of its kind in the whole mound.

These four stone implements represent the only specimens of the two lowest strata of the mound which are not chipped. A little above these the excellently polished tool 1–8925 (pl. 10, fig. 9) was found (in stratum VIII). This is the only one of such workmanship before the IVth stratum upwards. Therefore it is by no means impossible that rubbed or polished stone implements, excepting mortars and pestles, were unknown at the time of the origin of the lower strata, and that their use was rather limited in the succeeding strata. But the presence of mortar fragments and pestles in the lowest strata points toward a higher development of the human type than is usually expected of men who use flaked tools only.

It will have become evident from the foregoing remarks that the general zoological, geological, and anthropological facts which are available for fixing the age of the mound offer only indefinite evidence; uncertain even for an approximate dating of the time of the mound's beginning. They do not preclude the possibility of an age numbering many centuries; neither do they prove it. Under such circumstances it seems proper to take into account some more general considerations which appear in a study of the shellmounds of the bay as a whole.

We shall probably not make too great a mistake if we estimate the number of the larger shellmounds around the Bay of San Francisco to be over 100. So many and such enormous shellmounds can not possibly have been constructed by human hands unintentionally in any small number of centuries. Furthermore, they form a link of a larger chain of similar mounds which stretch northerly along the coast and inland from Southern California to beyond Vancouver and possibly still farther; *i.e.*, a distance of 18 degrees of latitude. The extension of such a similar manner of life over so great an area speaks of itself for the work of a great number of centuries. Even the complete development of this peculiar mode of existence, as represented in these mounds, must have taken centuries. And this is the more probably true since in those earlier stages of cultural evolution advances in the

manner of living were infinitely more difficult than they were later. Under these circumstances it is only possible to assume that the origin of the shellmounds in this region represents a historical development of more than a thousand, possibly many thousand years.[59] If this holds good generally for the origin of shellmounds among which the one at Emeryville is, judged by its height, the character of its contents in the lower strata, and the observed geological facts, by no means the youngest, we have still to consider on the other hand the limits of the time up to which these mounds may have been inhabited.

For a long time it has been customary to consider the last as well as the first occupation of the shellmounds as belonging to the remote past. The fact that in California no shellmound is known which is now inhabited or has been inhabited in historic time would speak for this assumption. However, many instances point to habitation of the mounds in the most recent times, not only in a few places, but in different parts of the whole inhabited world. And this cannot surprise us; for we can see primitive man reach into the most recent, nay, even the present time, in various parts of the globe. Thus, as is well known, the first discoverers described the Indians of the Gulf of Mexico as men "living in houses of mats erected upon hills of oysters."[60] R. Schomburgh attributes a large number of mounds made of snail shells, observed by him near the mouth of the Orinoco river, to the Warrow Indians, who are still living in that neighborhood. In the desolate coast lands of the at present dry mouths of the Ica river in Peru there are two enormous shellmounds which the writer has visited. Even now there remain large parts of the wooden huts which were left behind on these shellmounds by the last shell-eaters. Painted pot-fragments, patches of woven fibres, and all

[59] In a similar manner, Abbott, *l. c.*, p. 449, closes a long general exposition of the reasons which speak either for or against a relatively great age of the shellmounds on the Atlantic coast, with the estimate of an age of at least 1,000 years. His deductions are based upon geological reasons (the sinking of the coast) and the dissimilarities of the cultural remains found in the mounds. Peculiarly enough, D. G. Brinton, reasoning from the analogy of the cultural character of the shellmounds with that of the Indian tribes which the explorers met in this country, thinks he has found an argument against a comparatively high age of the shellmounds. W. H. Dall considers the lower strata of his well-explored Aleutian shellmounds to have an age of about 1,000 years. (Contributions, *l. c.*, p. 53.)

[60] Abbott, *l. c.*, p. 44.

kinds of bones lie scattered about. It would be an easy matter to show that the last inhabitants of the hill exhibited the later cultural conditions which prevailed during the time of the Incas in the valleys of Pisco and Ica, about 1460 A.D.

Returning to California, there can be no doubt that the hill-like camp places of the Indians in the interior of the country represented a local variation of the shellmounds along the shore. The form and structure of these camping places resemble the shellmounds of the coast. The material differs in part, since the inhabitants of the inland had fewer shells at their disposal. These camping places were inhabited by the Indians quite recently, or are even now inhabited.[61] The time when the shellmounds of the Bay shore were vacated by their owners was therefore probably not very long ago. With this view coincides the fact that in the upper strata of the shellmound burial is represented by cremation; a form of burial observed up to the most recent times among the Indians of California. The white immigrants settled first on the seacoast, and it is therefore natural that the aborigines retreated earlier from their shellmounds than their brethren in the interior did from their camp places.

Thus, while the history of the shellmounds of this region probably reaches back more than a thousand years into the past, it must have extended almost to the threshold of modern times. The fact that their roots reached far back into the prehistoric period of California does not prevent our seeing the tops developing almost to the present day.

Cultural Stages Represented.

If we attribute to the shellmound an age representing many centuries, cultural differences should be indicated in the successive strata. For it is impossible that the cultural state of one and

[61] The old Indian camping place at Knight's Landing (on the Fair Ranch), at the mouth of a tributary of the Sacramento river, was inhabited, according to authentic information (T. Coleman), as late as 1849 by 150-200 "Digger" Indians. They departed in 1865. The shells, of which only a small number have been found, are of *Mytilus*. A similar mound in Colusa county, 20 miles to the northwest, is still populated by Indians. The Wintun Indians are still accustomed to obtain shells for food by diving into the river. This caused Powers (*l. c.*, p. 233) to surmise that a race somewhat like theirs might have erected these shellmounds.

the same place should have remained stationary for many centuries and, even judging by the mass alone, the mound could not have reached such a height in less than a considerable number of centuries. In attempting to discover possible cultural differences we unfortunately meet with several difficulties. The action of the climate has destroyed in all the strata the objects which consisted of perishable materials. Only the more resistant things remained. But the perishable materials are frequently those in which the decorative sense of man expresses itself most easily, and in which cultural differences are most distinctly shown. A further unfortunate circumstance arises from the general trend to simplicity and primitiveness of the tools of the inhabitants of all shellmounds. So that the visible cultural differences which would generally appear with a people of changing forms of life are imperfectly expressed. Finally, many objects give only partial evidence as regards form and use, for they were often mutilated previous to their deposition in the strata.

In examining the implements of successive layers of the mound we find that awls and certain knife-like tools found in nearly all known shellmounds are met with in all of the strata, while ornaments consisting of *Haliotis* shells and other simple objects of decoration made of shells, corresponding in general appearance to those which are still in use among the Indians, are met with in the graves of the VIth to the VIIIth strata. In the deepest strata, however, there have not been found any bone beads, ornaments of *Haliotis* shells, or saw-like tools such as are known above the VIIIth stratum. Thus there is some support for the suggestion that cultural differences are expressed in the history of the mound.

One of the most striking differences indicating a change in the character of the people whose cultural stages are represented in the successive strata is found in the different forms of burial. The use of cremation appears for the first time in the 4th stratum and extends to the upper, completely undisturbed stratum (II). In the IVth stratum out of 11 bone awls only 4 are calcined, while in the IInd stratum 44 in 61. In the latter the great amount of ash intermingled with calcined human bones becomes very noticeable. Powers relates in his great work on the California tribes

that most of them practiced cremation, and concerning the Karok, Yurok, and Wintun he relates that they bury their dead, while the Yokuts under certain circumstances make use of both customs. The inhabitants of the upper strata of the mound may undoubtedly be assumed to have followed the customs of the majority of modern Californian tribes in the disposal of their dead. Contrasting with this custom is burial in the ground. In this connection interesting evidence is furnished by the strata of this mound: here at least cremation was preceded by interment. In strata IV to VIII of this mound we find this custom prevailing, and we are forced to assume it to have been practiced by the population living on the mound during the time from the deposition of the lower part of stratum VIII to that of the middle of stratum V. In their manner of burial the knees were drawn up, resting upon the side, resembling on the whole the mode of burial in the shellmounds of Santa Barbara county in California, and in those found in Oregon. Instead of suggesting that the mode of burial is a recent one, the findings in the lower strata of the mound at Emeryville might hint that possibly the shellmounds of Southern California and Oregon are older than is at present believed. The Yokuts likewise bury their dead with drawn-up knees, but whether lying on one side is not mentioned. Also of the Wintun detailed information as regards their mode of burial is missing. But even if a majority of tribes should still practice the form which prevailed in the middle strata of the mound, this would not change the fact that the whole mode of burial at this place designates an earlier ethnical stage. The manner in which the inhabitants of the lower strata of the mound—say from the bottom portions of the VIIIth stratum to the bottom of the Xth—buried their dead is not known, because no graves or other evidences of burial appear in them. It is not impossible that their mode of burial differed again from the two kinds of burial found in the strata lying above.

Another striking difference between the upper and lower layers is found in the characteristic implements of the strata. This difference is best represented by a comparative table. In order to understand this better, we give the relative volume of earth moved for each stratum. In the table the volume of the VIIth

stratum (about 100 cubic feet) has been taken as the unit. Bracketed figures in the different columns denote the number of objects which might have been expected as the proportional content of one of the middle strata. In the last two columns the contents of the IXth stratum have for practical purposes been used as a basis.

Layers	Relative Contents	Rubbed* stone implements	Obsidians	Flaked stone implements excepting obsidian		Knife-like implements		Rough awl-like implements
I	5.5	2[5]	2[2]	—		[6]		—[8]
II	10.6	24[10]	11[5]	6[10]		[13]		—[16]
III	7.3	3[7]	4[4]	4[7]		[9]		—[11]
IV	4.2	4	2	4		[5]		—[6]
V	3.4	4[4]	1[1]	5(2)		[4]		—[5]
VI	1.5	—[1]	—[1]	3		[1]		—[2]
VII	1	—[1]	2[1]	6		[1]		—[1]
VII[a]	2.2	—[2]	—[-]	9		1[2]	5	[11]
VIII	7.4	1[7]	1[4]	24	(28)	1[9]		—[3]
IX	3.3	—[3]	1[2]	62		4[4]		5[5]
X	1.8	—[2]	—[1]	17		—[2]		4[3]

Parentheses in the 4th column denote the number of chipped stones which may actually be assumed as tools.

It is evident that the character of the objects in the upper strata is entirely different from that of the implements which are found in the lower beds. Well polished stone implements and obsidians diminish the nearer we come to the bottom. The sporadic occurrence of a well polished stone implement in the 8th stratum of the first column has an entirely abnormal aspect, in view of the otherwise complete absence of such objects from the VIth stratum downward. The abnormal increase of objects of the 1st and 2nd kinds in the IInd stratum is doubtless due to the custom of throwing their possessions into the fire during the cremation of the dead. Still, the IInd stratum yielded a sufficient number of fragments of similar objects which were evidently lost in other ways. So few are furnished by the contents of the lower strata that their limited use is apparently indicated. In fact, even the Vth stratum shares this poverty, for its four polished implements are only represented by fragments of metate-like stones and a tablet of slate, polished on one side. In the lower strata flaked stones (of local materials), bone splinters of an awl-

* Except mortars and pestles.

like shape, and knife-like tools of bone predominate. Among the flaked stones, real implements are very numerous; they are missing in the upper strata. Their technique is primitive. On one side they are flat and are worked on the other side only. This working, too, is crude, and the finishing primitive. The turtle-back form is present. Different kinds of scraper-like tools of primitive form, and of drill-like sharpened stone fragments, must have been more common implements in the hands of the inhabitants of this stage than among the dwellers on the upper strata, where these tools are lacking.

A well formed implement of flaked stone, worked on both sides, was found low down in stratum VIII (a spear-like blade, pl. 10, fig. 14). Strata IX and X offer nothing similar. The leaf-like blade from stratum VIII (pl. 6, fig. 20), where a crude workmanship is paired with an attempt at more regular sharpening of the edges, does not favor the view that the inhabitants of the mound had been well versed from the beginning in the production of chipped implements.

Very remarkable is the occurrence together of crude splinters of bone, which show from long use their real value as tools, and the neat, almost elegant, knife-like implements. Among the latter we find the only ornamental fragment of a tool of bone obtained during the whole course of the excavation. The people who used the splinters of bone for their tools were not so primitive but that they possessed elegant objects of bone, and not so far advanced but that they were often satisfied with such primitive implements as common bone splinters. But both classes of these typical tools are markedly different from what the upper strata of the mound offer in the line of implements. Hence the people of the lower strata must have represented a somewhat different mental type or a different degree of mental training.

It seems advisable, from what we know, to separate the older inhabitants who had settled here and raised the foundations of the mound up to the middle part of the VIIIth stratum, from the later population of the grave period. They may have been neolithic, they may have been connected with the following generation by some common traits, although there is little evidence for this; but the two people certainly differed in cultural characteristics.

The race that commenced building in the middle of the 8th stratum was apparently less different from the population of the upper strata than from its predecessors. But differences can here, also, be discovered. The chipped tools of local materials still continue for some time (about to VII*a*), and obsidian seems to have come to them as a rather rare material. Only a few bone implements from grave 8 are extant in this group of strata. Contrasted with the usage of the people of the upper strata is also the use of bone arrow blades, which the last inhabitants of the mound apparently did not possess. They had not yet departed from an extended employment of bone as a working material; a fact usually more characteristic of a primitive people than of one further advanced.

One observation should still be made in this connection. It is a striking fact that in the fifth stratum and its immediate proximity a number of objects appear, the likeness of which was not found elsewhere in the whole mound. They are:

(1) Fragments of metate-like stones, stratum V.
A long, dull, chisel-like tool of horn, from stratum V.
A tablet of slate polished on one side, stratum V.

(2) Pieces of antlers, truncated for use as tools, stratum V, and a knife-like implement, stratum V.

It seems possible that such sporadic types of tools were left by a people that only temporarily inhabited the mound. Since, however, up to the present time parallel investigations have furnished but little material, such an hypothesis cannot be tested as to its exactness; nor is it possible to state from what region they might have come.

PART II.—ARTIFACTS UNEARTHED AT THE EMERYVILLE SHELLMOUND.*

The artifacts, complete and fragmentary, unearthed during the excavation of the Emeryville shellmound are of stone, bone or horn, and shell.[62] In number, the objects of bone and horn about equal those of stone, or if the large quantity of chipped stone in the lower strata be deducted, being mainly workshop chips, the bone specimens are even in the majority. Although shell heaps usually abound in bone implements, the large number of such implements recovered in this mound is quite remarkable, especially since the mound at West Berkeley, only two miles distant, seems to possess a much smaller number of them. There the bone implements recovered bear the proportion of from 1:5 to 1:10 of those of stone, so in the case of bone implements we find verification of the observation regarding the less frequent occurrence of the bones of animals as waste in proportion to other waste.[63] The occupants of the West Berkeley mound being essentially fishermen, apparently gave less time to the chase, and as a result may have neglected handicrafts in which bone implements were used.

A. Implements made of Stone.

a. Made by Grinding.

1. Mortars.

Stone mortars were among the most common and most useful implements that the ancient inhabitants of the land possessed, being used for the preparation of meal and for other purposes.

* For the final literary form of the second half of this paper P. E. Goddard is responsible.

[62] Remains of pottery are found in quantities in the shellmounds on the Atlantic Coast (cf. Abbott, *l. c.*, p. 43*a*), and also in those of other localities (Brazil, Peru). They do not, of course, appear in California shellmounds since stone pots and baskets were used in their place at all times.

[63] The specimens of bone implements recovered in shellmounds are of great importance in the study of the use of such implements among primitive peoples, since they are so rarely found in other fields of research (cf. also Abbott, *l. c.*, p. 205). Still shellmounds greatly differ in this respect. While bone implements are "quite abundant" in the shellmounds of New England, the same as here (Wyman, Am. Naturalist, 1, p. 581), the mounds in New Jersey yield only one bone to every 3,000 stone implements. (Abbott, *l. c.*)

Correspondingly numerous therefore are these objects, found mostly in fragments, and scattered through nearly all the strata from the second to the tenth. There are three perfect specimens and eleven fragments in our collection, nearly all made of lava. The largest of the mortars, 1–9102, fig. 3, was recovered quite accidentally near g in plan III at the extreme western end of

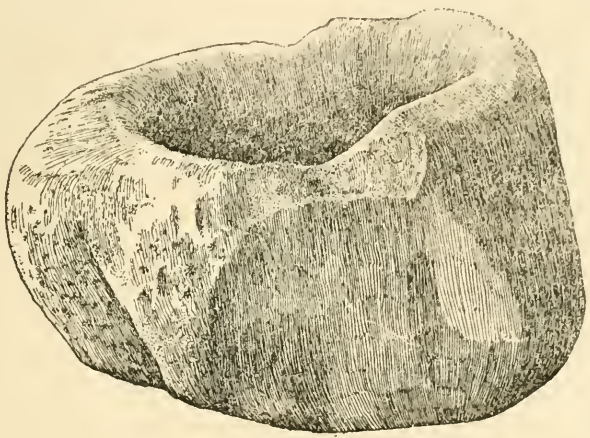

Fig. 3. × ¼. A large mortar.

the mound. Judging from the place of its discovery, about 3½ inches below the surface, the mortar must have been lost in about the middle period while the foot of the mound was increasing from n to p. Its outside surface is rough like the natural boulder, it is 1 foot long by 9 inches wide and 7½ inches high. Within it is oval and measures 6 to 7 inches in diameter and 5 inches in depth. The smaller mortar, 1–8705, fig. 4, was found in stratum VI. On the outside it is rounded off and ornamented with engraved vertical lines, which are intersected near the edge by a horizontal one. The edge is partly worn away by use. Such simple lines as an ornamentation of the outside are occasionally observed on California mortars.

1–8664, fig. 5, a small mortar from stratum III, is of different shape, oval both in its outline and in cross section, the bottom being slightly flattened; it has a rather small round cavity, 1½ inches in diameter and one-sixth inch deep. It may have served

for the pounding up of substances which were used only in small quantities, such as color pigments. The width of this mortar is 2½ inches, its height and thickness 1⅞ inches. Powers presents a view of a similar specimen from California, a proof that this type occurred in this region. A fragment, 1–8810 of the collection from stratum VIII, may be the bottom of a similar utensil.

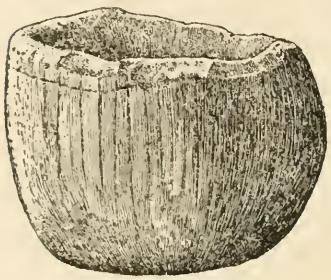

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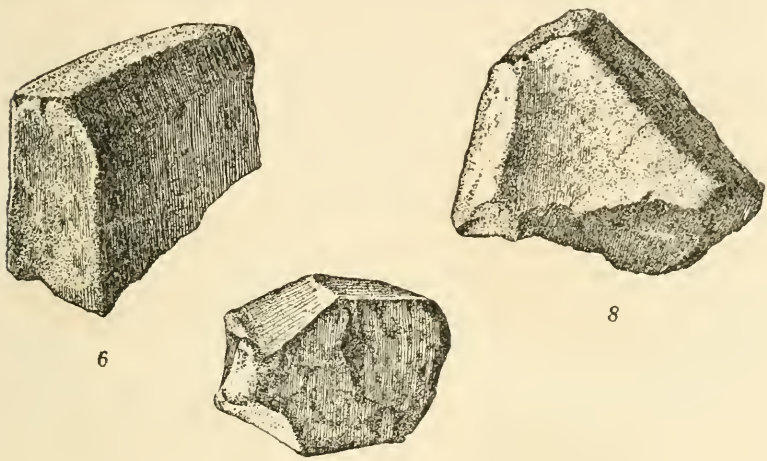
Fig. 4. About one-half natural size. Fig. 5. × ¾. Small mortars.

Some additional types of mortars are represented among the fragments; they will be given below in the order in which they were recovered. 1–8594, fig. 6, from stratum II, is one of several fragments of this stratum and belongs to a relatively advanced type, resembling a vessel. These stone vessels had a fairly even thickness of the sides of about an inch, and were fashioned quite regularly without and within. This rim is flattened and slopes inward. The diameter of the complete mortars may have been a foot. This type of mortar is quite common in California. The collection from Santa Rosa Island in the University Museum made by Dr. Jones contains several similar specimens. 1–8707 fig. 7, stratum IV, is an odd fragment. Its well fashioned bottom part is surrounded by a rim which in turn is bordered by two chambers which exactly correspond; the surface between them is broken. This fragment may also have been part of a mortar, although it is not possible now to restore it to any shape represented among the familiar types. Fig. 8, 1–9077, shows a fragment of a mortar recovered in the Xth stratum, and it is the only one found lower than stratum VIII. It lay hardly an inch from the base of the mound. It has a peculiarly jagged shape; the

convex exterior is the rough bowlder stone, as are the uneven sides, but the inner concave surface is ground down smooth. The peculiar jagged shape may be explained by the fact that it is a piece of a mortar, the rim of which by long usage had been worn away in places, and as a result points were formed. The collec-



Figs. 6, 7, and 8. × ½. Fragments of mortars.

tion of Dr. Jones from Santa Rosa contains a mortar with a jagged rim, caused probably also by wearing away, but in that case the points of the rim show some decoration, unlike the present fragment. 1–8848, fig. 9, stratum VII*a*, may throw some

Fig. 9. × ⅔. Fig. 10. × ½. Fragments of mortars.

light on the possible cause of these indentations resulting from long usage. In the latter specimen the surface of the bulging portion is rough, as in 1–9077.

The small fragment, 1–8621, fig. 10, stratum II, has to be included also in the class of mortar-like utensils. It is made of a soft material resembling steatite, it curves as if it were a handle and is broken off at one end, while the other rounded end shows marks of blows. This object may be compared to the handle of the cup-shaped vessel of steatite from Dos Pueblos in Southern California and shown by Professor Putnam, l. c., pl. VI, fig. 5 (cf. l. c., p. 110). Similar utensils from Santa Catalina Island and other places are mentioned there; hence it may be assumed that this type of utensils was used by the occupants of the mound during its last period.

Fig. 11, 1–8533, from stratum I, shows a stone fragment, hollowed out like a mortar. The upper rim of the specimen must have had a sharp angle, as the outer surface is almost vertical while the concavity is rather shallow, forming a cup with a considerable diameter.

11

12

Fig. 11. × ½. Fragment of a mortar. Fig. 12. × ½. Fragment of a stone used for grinding.

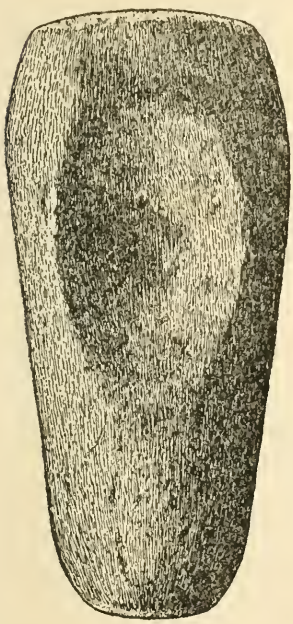
2. Flat Stones.

It is only from three small fragments that the presence of this type within the mound may be inferred. All three were recovered in stratum V; one of them, 1–8751, is shown in figure 12. Judging from the fragments, these grinding stones were square in shape, about 1½ to 2 inches in thickness and were worn smooth, both on the horizontal surface and on the sides and ends. The occurrence of flat grindstones is not unprecedented in California: some have been found in Sonoma county[66] and elsewhere. They were perhaps used in the manufacture of shell ornaments and beads.

[66] Moorehead, *l. c.*, p. 291.

3. Pestles.

Many fragments having the usual form were found, but only one was perfect, and that of unusual shape. 1–8670, fig. 13, was recovered in cut A, 6 inches below the surface. It is 6⅜ inches long, 3 inches wide, and 2⅛ inches thick, tapering toward the pestle-like rounded end, the other end being flat. Marks on it show that it was also used as a hammer. Sunk into one of the sides, at about the center of gravity, is a long conical groove about one-third of an inch deep; the opposite side shows the beginning of another such groove. They may have been worn into the stone by using the broad side of the implement in driving stakes, etc.



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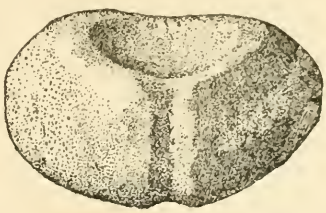

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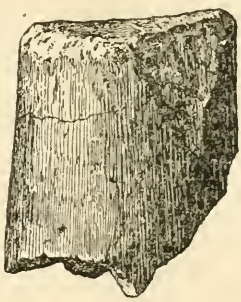
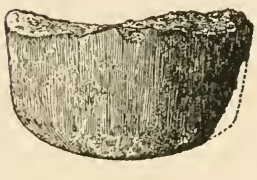


15

Fig. 13. × ½. Pestle with depression on one side. Fig. 14. × ½. A grooved sinker. Fig. 15. × ½. Upper end of a pestle.

The beginning of a second groove, otherwise superfluous, on the opposite side seems to bear this out, as do the marks on the surface of the broad end. These latter indications are a proof that the utensil was not used as a pestle only. This is not the only instance of a pestle with side grooves. Ch. Rau pictures a very

similar one from Tesuque in New Mexico.[67] Mr. Stevenson's opinion that the side grooves served for holding the pigment which had just been ground by the pestle seems to be merely a conjecture on his part. A stone was found in the West Berkeley shellmound which seems arbitrarily to combine several purposes, —a groove encircling it shows its use as a sinker, a semispherical cavity which at its widest part breaks into the groove points to its use as a mortar.



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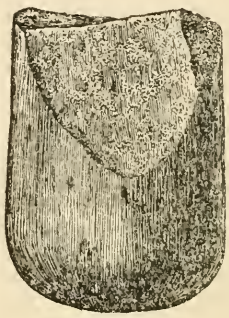

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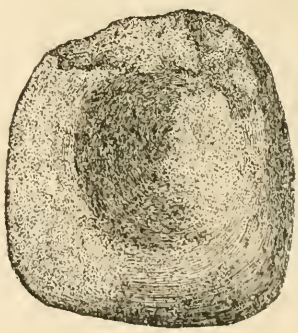

18

Fig. 16 and 17. × ½. The lower ends of pestles. Fig. 18. × ½. Stone used for hammer with depression for fingers. Fig. 19. × ½. A new type of implement of unknown use.

[67] Observations on the cup-shaped sculpture in Contrib. to North American Ethnology, 1882, V, fig. 39, with p. 47 repeated by Stephen D. Peet in The Moundbuilders, 1892, I, p. 5, fig. 5.

The 17 fragments of pestles of usual shape were fairly uniformly distributed throughout all the strata, as was the case with the mortars. However, 7 of these came from stratum II alone. There were no peculiarities to be noted in the fragments as to their forms. They were about 2½ inches thick and were rounded off at the lower end. The upper end sometimes tapered after a conical swelling immediately next the grinding surface. They were cut straight off at the upper end, unless indeed the abruptly cut surface is the result of a previous breaking. Sharply pointed or button-like ornamentations at the upper ends which are usual in those found in California[68] were not noticed. Figures 15 to 17 show three fragments,—1–8882, 1–8597, and 1–8666 from strata VIII, II, and from the cut A. Of these, the first illustrates the upper end of a pestle, the other two, lower ends.

The little object 1–8620 from stratum II, plate 12, fig. 11, seems to be best included under pestle stones. It is made of fine grained stone, which would point to its use for more delicate purposes. It is a truncated cone, with oval section, 1⅛ inches wide and 1$^{3}/_{16}$ inches thick. The lower base is slightly arched and, as can plainly be seen, is scratched slightly by use; a small middle cavity in the narrow upper surface shows traces of asphaltum. It may have been used as a pestle.

4. Hammer-like Stones.

Strangely enough, only two such implements were found in this mound, while in the West Berkeley mound several that conclusively belonged to this class were unearthed.

One of these, a boulder stone the size of one's fist, oval in shape and flattened, was found in the lowest stratum, X. The marks of blows making the side edges uneven show its use as a hammer. The other, 1–8720, fig. 18, from stratum IV, is one of the familiar type having a groove for the insertion of the fingers. It is a stone 3¼ inches long, 3 inches wide, and of an uneven thickness not exceeding 1⅝ inches, flattened off at its thickest (lower) end. There is a depression in each of the broad sides. The surface of the indentations is dotted with small holes. Similar stones have been found in many places in the United States.—in

[68] Putnam, *l. c.*, pp. 87-89; Moorehead, *l. c.*, p. 290.

New Jersey, Pennsylvania,[69] on the Aleutians,[70] and elsewhere. Abbott has pointed out the fact that the edges of some of these stones could not very well have been used for hammering since they do not show the signs of such usage. The stone in question was evidently used in two ways,—as a hammer at the lower flat surface, which is from five-eighths to 1⅛ inches wide and in this case provided with indentations serving for the insertion of the finger; and as a hammer at the flat sides for the driving of stakes, etc., in which case it was grasped by the rims. The pits in the depressions were probably the result of this latter use of the implement. The writer has noticed that just such flat stones were used in Bolivia for the driving of stakes, and there, too, the broad side which gave the blow was pitted. The material used is hard sandstone.

5. Flat Stones Pointed at both Ends.

Two objects of this form, coming from stratum II, represents a new type of implement. They are almost identical in shape. One of them, 1–8604, is shown in fig. 19. They consist of long, flat, quadrangular boulder-stones, 3⅝ and 3⅞ inches long, with an even width and thickness of 1⅝ inches. Both ends are simply sharpened to a point, and the broad sides, top and bottom, are shaved off as far as the middle of the stone. In form, the stones are similar to a wooden top of today.

6. Sinker-like Stones.

Stones of this description form a large class, exhibiting, however, great diversities of shape. They all seem to have served the same purpose since most of them show indisputable signs of such usage.

About 18 stones of this kind were found in the mound. As regards their varying form and utility, they may be classed as follows:

I. Spherical and oval stones with a peripheral groove: Fig. 20, 1–8669, shows a spherical stone of this kind, found at a depth of 5 feet in cut A. 1–8534, fig. 21, a fragment of an oval stone with a groove about its largest circumference is from stratum I.

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[69] Abbott, *l. c.*, pp. 425 to 431, figs. 399 to 404. Chas. Rau, *l. c.* Smithson. Contrib., No. 297, Vol. XXII, p. 20, figs. 80 to 81, and p. 22.

[70] Dall, *l. c.*, p. 55.

II. Flat boulder stones with notches in the corresponding sides for fastening them: Two of these were found in the upper strata; one, from stratum IV, is shown in figure 22.

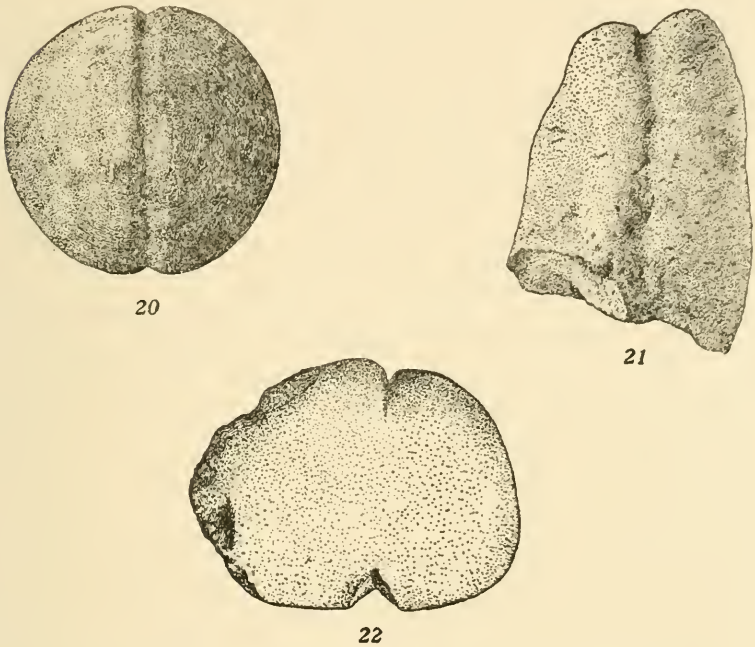

Fig. 20. × ½. Figs. 21 and 22. × ¾. Sinker-like stones.

III. Stones with holes pierced through them by which they were suspended: These form the type that may with the most certainty be classed as sinkers. 1–8535, plate 12, fig. 7, from stratum I, is the only specimen of this class found.

IV. Pear-shaped and kindred stones; also conical pendant stones: The fourth class is the largest, in that the greatest number of shapes may be included in it. The following are to be counted in with this class:

a. Pear-shaped stones and others, though slighter, still very like them. This type is represented by:

1. A perfect pear-shaped stone, 1–8611, plate 10, fig. 2, from stratum II.

2. More or less fragmentary bits, 1–8612, 3, the first without a doubt, the second probably from stratum II. See 1–8613, plate 10, fig. 1.

3. Five fragments of stones of a slenderer, less perfect though similar form, 1–8614, 5 and 6 (plate 10, figs. 5, 3, 8), 1–8617 and 1–8718 (plate 10, fig. 4), the latter one from stratum IV, the others from II.

b. Inverted pear-shaped stones, some flat. This shape is related, though distantly, to the above. Two fragments, 1–8618 and 1–8619, from stratum II, see 1–8618, plate 10, fig. 6.

c. A conical stone with slanting lower surface (1–8719, plate 10, fig. 7) from stratum IV. It is very similar in shape to the upper part of the pear-shaped stones.

d. A pointed stone, 1–8925, from stratum VIII, plate 10, fig. 9, which is only very distantly related to the pear-shape forms.

These stones belong to that class of objects which have been interpreted at different times as being:

1. Weights for determining the vertical.
2. Weights for weaving apparatus.
3. Weights used in spinning.
4. Weights used for fishing nets or lines.
5. Ornaments.
6. Medicine stones or charms.[71]

A number of articles under class IV (Form IV*a*) are made of hematite.[72] Of the objects under consideration, 1–8925 (plate 10, fig. 9) is made of the same. The use of hematite generally presupposes that an implement is going to be employed as a weight. Since the forms that belong to this class merge into one another in an uninterrupted series, one is justified in assuming that they were all weights.

It is further clear that the shape of the pear-like stones, which have caused so much speculation, must have been fitted for some particular purpose. This is to be inferred from the fact that stones of like shape have been found in widely separated parts

[71] Dr. L. G. Yates, Smiths. Rep., 1886, pt. I, p. 296, further explained in Bulletin of the Santa Barbara Soc. of Nat. History, No. 2; Moorehead, *l. c.*, pp. 249 to 250, etc.

[72] Abbott, *l. c.*, p. 232, fig. 220, from Illinois; Rau, Smith's Contrib., p. 27, No. 101, from Tennessee (cf. for both pl. VIII, fig. 2); Moorehead, *l. c.*, p. 251, fig. 29, from Santa Barbara, Cal.

of the United States outside of California, in Maine,[73] Massachusetts,[74] Ohio,[75] Illinois,[76] and elsewhere.

Furthermore, H. H. Bancroft[77] has made the important assertion that such implements are usually found in a mutilated condition. This is borne out by the fact that out of the nine pear-shaped and inverted pear-shaped stones represented by groups 4*a* and 4*b*, there is only one which is perfect. It is to be inferred from this that, however elaborately they are ornamented, these implements were put to essentially practical uses. Hence the theory that they were worn as ornaments or charms is untenable.[78]

The supposition that they were used on the end of a plumb line is also invalid, since civilization was not far enough advanced among the Indians for that sort of thing. Weaving and spinning apparatus requiring the use of the stones as weights are so rarely found that we cannot explain the presence of such a large number of stones in that way. And especially not in California since the Indians there have never spun nor woven.

Hence the only explanation left is that they were used in fishing. The great quantities of such implements found on the coast has often been noted.[79] That nine were found in a shellmound such as the one at Emeryville substantiates this theory. They have also been noticed in a number of other shellmounds about the bay (even though these have been little excavated), as at Ellis Landing and in Visitacion Valley,[80] and their shape is identically the same (plate 10, fig. 2). There is one from a shellmound on Seaver's Ranch with exactly the same shape, plate 10, fig. 1. Drawings were made by J. Deans of two other objects

[73] Moorehead, *l. c.*, p. 92, fig. 113.

[74] Rau, *l. c.*, p. 27, figs. 105-106, Abbott, pp. 228 and 230, figs. 216 and 218.

[75] Abbott, *l. c.*, p. 233, fig. 222, Rau, fig. 103.

[76] Abbott, *l. c.*, pp. 232 and 233, figs. 221 and 223.

[77] Native Races, IV, p. 711.

[78] According to Dr. L. G. Yates, Bulletin 2 of the Santa Barbara Soc. of Nat. Hist., the California Indians regard such pear-shaped stones as charms and use them as such. This is analogous to their superstitious belief concerning stone hatchets whose original significance has long been forgotten and hence is no explanation of the original use to which these articles were put.

[79] Cf. F. W. Putnam, *l. c.*, p. 195.

[80] See Illustration in H. H. Bancroft's Native Races, IV, p. 711.

which were also taken from the same shellmound in Visitacion Valley and which had like forms.[81] If we accept the hypothesis that these stones in general are sinkers, there are of course difficulties in the case of individual stones, that must be explained away. The following peculiarities which appear must be mentioned:

1. Occasional peculiarities in material: Some are not very heavy, some rather soft; and in others the ornamentation either in color, grain, or crystalline markings is so prominent that an ornamental use is suggested. 1–8615, plate 10, fig. 3, seems to be a stone of this description,—the material of which it is made is reddish and fine-grained, and ornamented to some extent.

2. The occasional absolute lack of any contrivance by which the implement might have been suspended: 1–8925, plate 10, fig. 9, is, for instance, of this kind. It is for the greater part of its length absolutely round and gradually tapers to a point. The outer end is in the form of a handle which is flattened to about one-half inch wide and one-quarter inch thick and is rough from the marks of blows; the main part of the instrument is smooth. The handle-like part must, from its form and roughness, have served to fasten it by. It looks, however, more as though it were intended to fit into a shaft, rather than to be suspended. It is important to note that one of the long sides is entirely covered with asphaltum. This fact excludes the possibility that it was fastened into a shaft. It must further be called to mind that, as in the case of the California Indian dancing costume, various rod-like bits of stone are sometimes fastened on by means of hangers, the provision for their suspension being made on the stones themselves. The use of asphaltum in securing them often did away with otherwise necessary changes in their form. At any rate it allowed great imperfection in form.

Fragment 1–8616, plate 10, fig. 8, is an example of the above; it is pear-shaped and the upper conical point is encircled by a broad band of asphaltum which served for its attachment.

The sinker-like stones of classes I-III present fewer difficulties in their explanation than do the pear-shaped and kindred ones.

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[81] Journal of the Anthropological Institute, *l. c.*, p. 489.

The use of flat boulder stones with side grooves as net-sinkers is agreed to by all.[82] The fact that here as in the East, and as in the shellmound of West Berkeley, many of these have been found in groups, points almost conclusively to their use as net weights.

Professor Putnam has already called attention to the use of spherical stones (fig. 20), with a peripherally encircling groove as sinkers.[83] Similar stones are also found in shellmounds in Massachusetts and in the Aleutian Islands.

Dr. Yates[84] was informed by an Indian that such was the use of a stone found in Napa (California).[85] The use of the oval stones (as fig. 21) is in general to be explained in the same way. A stone of that kind is, for example, known to have been found in Oregon.[86] Another one has been found in California (supposedly at Spanish Flat). It has been pictured by H. H. Bancroft.[87]

The stone, 1–8535, plate 12, fig. 7, from stratum I, is a sinker, judging from its general shape; it is long and oval, pierced at the upper end. Stones of like form have been found in numbers in the shellmound at West Berkeley. They are probably sinkers like many other stones found there.[88] The upper eyelet has been broken off in the stone under consideration. The stone is slightly flattened; one of the end surfaces is more curved than the other and one of the broad sides more elaborately adorned. On one side a lattice-like ornamentation joins on to a deep groove. On the other side may be seen several somewhat ruder lines like hatchings. The material is that commonly used. Abbott describes an ornamented stone pendent as a gorget and another one

[82] Cf. particularly Abbott, *l. c.*, p. 237.

[83] *l. c.*, p. 203.

[84] Bulletin, *l. c.*, pl. III, fig. 22, and p. 17.

[85] Spherical and oval stones with a peripheral groove are implements of a very simple form and hence they lend themselves to different uses. The old copper fac-simile of a stone hammer in the Museum of Science and Art in Philadelphia shows conclusively for the region in which it was found, *viz.*, Lake Titicaca, Pako Island, in Bolivia, that similar stones were used as hammers.

[86] Rau, Smiths. Contrib., No. 318, p. 27, fig. 110.

[87] Native Races, IV, p. 705.

[88] Sinkers provided with a hole and of like shape are in use among the Western Eskimos. See J. Murdock, in IX, Am. Rep. of Bur. of Ethnology, 1887 to 1888, p. 282, fig. 273. They are found in great numbers in the United States.

from Illinois with plastic ornaments, as a sinker.[89] Compare this with a picture of a pendent stone from San Clemente Island.[90] The fact that these stones are ornamented seems to make their use as sinkers doubtful but not impossible, since fish-hooks are sometimes much ornamented.[91]

Plate 12, fig. 8, 1–8630, is somewhat sinker-like, but in many respects it diverges from the general class. It is made of very light, soft stone, and is an elongated oval in shape, with five grooves parallel to one another cut in about the edge. It is elaborately ornamented with oblique hatch-like lines on the edges between the grooves. Hence it is improbable that it was a sinker —it cannot, however, as yet be assigned to another use.

7. Cylindrical Stones.

These differ from the pestles in that their diameter is smaller and that they bulge out only slightly toward the middle. Two objects of this kind came from stratum II, of which 1–8609 is shown in plate 10, fig. 10. Both are broken at their ends. They are respectively $4\frac{13}{16}$ inches and $2\frac{5}{8}$ inches long and fifteen-sixteenths inch and 1 inch thick. The surface of the break in the shorter one was subsequently smoothed off; perhaps by using it as a pestle. Long cylindrical stones of this kind partly flattened on one side and having encircling grooves at the tapering ends have been pictured by Yates[92] and Moorehead[93]; these were found at Santa Barbara, Southern California. To these may also be compared a stone pendant from Tuolumne county[94] pictured by Moorehead, since the lack of complete ends in the stones gives considerable room for speculation as to what the whole form might have been. On the other hand, the tentative designation of them by Moorehead and Yates as charms is in no way justified. The better interpretation of their use would be that of sinkers especially in the case of those provided at both ends with grooves

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[89] *l. c.*, pp. 398 and 234.

[90] Putnam, *l. c.*, p. 209, fig. 81.

[91] Among the Thlinkites conys Niblack.

[92] *l. c.*, pl. IV, figs. 32, 33, so. Smiths. Reports, 1886, I, partly, pl. IV, figs. 32, 33, pp. 296 to 305.

[93] *l. c.*, p. 251, fig. 381, Nos. 30 to 33.

[94] *l. c.*, p. 249, fig. 380, No. 1.

for attachment,[95] since stones coming from Peru[96] which are undeniably sinkers are very like these in many respects.

8. Needle-like Stone Implements.

An awl, 1–8608, plate 12, fig. 10, of stone, comes from stratum II. Plate 12, fig. 9, 1–8711, from stratum IV, is piereed and similar to the above though needle-shaped.[97] From seratches appearing on 1–8608 we infer that it was used on rather hard materials.

9. Tobacco Pipes.

It is remarkable that tobacco pipes were found only in stratum II; of these we have five perfect specimens and one fragment. This bears out the statement made above, that stone utensils well-made and smoothed off were found only in the upper strata of the mound and particularly in stratum II. Since it is not probable that the inhabitants of the lower strata were ignorant of the practice of smoking, the absence of pipes must be explained in some other way. On the one hand it is possible that many of the older pipes were made of wood. Powers has described a number of wooden pipes in use among the Indians of today. On the other hand, it is possible that the practice of smoking was not so common in remoter periods and therefore it would be likely that fewer pipes would be found. There is a third possibility, that the large number of pipes found in stratum II is dependent on the method of disposing of the dead, so characteristic of this stratum and which caused articles to be preserved which would otherwise have disappeared. The pipes described below represent two primitive types, with some insignificant variations.

Plate 12, figs. 2*a* and (cross section) 2*b*, 1–8622, represents one type. It is made of a soft serpentine-like material, gray on the broken surface and reddish brown on the outside. It is one and seven-eighths inches long and incomplete. There is a broad bowl-like part and a narrow neck or stem, a prolongation of it. The bowl is conical, one and one-eighth inches long and of inconsiderable width, being three-fourths of an inch in diameter. The "boring" of the stem portion is cylindrical and eccentric.

[95] Cf. V. A., also flat specimen, Smiths. Rep., I, pl. IV, fig. 30.

[96] In the Museum of the Univ. of Philadelphia.

[97] Prof. Putnam, p. 211, in figs. 87, 88, from Santa Barbara.

Plate 12, figs. 3*a* and 3*b*, 1–8623, is the only representative of the second type. It is made of green serpentine, and is two and one-sixteenth inches long, tapering into a tubular shape. The hole in the stem is as above, only at the mouth end it is conical and shorter. A groove is cut into the tapering end.

Plate 12, figs. 1*a* and (in section) 1*b*, 1–8624, is made of soft gray stone and is very similar to the preceding one, except that it lacks the groove at the mouth end and that it is shorter and thicker.

Plate 12, figs. 4*a* and (in section) 4*b*, 1–8626, is a small cylindrical object only nine-sixteenths of an inch long and seventeen-thirty-seconds of an inch wide. The seven-sixteenth inch conical hole takes up nearly the whole width of the stem so that the rim surrounding it is sharp. The short conical boring at the stem end is only five-sixteenths of an inch wide. The proof that this too was used as a tobacco pipe lies in the fact of the disparity of the two conical borings and in that the entire width of the bowl end of the pipe is used to the best advantage. It seems to have been more of a miniature or toy than an article in common use. However, the quantity of tobacco needed to fill any of the pipes could not have been great since the cone-shaped cavity in the bowl is so small. One is here reminded of Schumacher's entertaining description of the way in which a Klamath tipped back his head in order to raise his pipe vertically that he might lose none of the tobacco. The stem ends of the pipes are equally imperfect. They must certainly all have been fastened to a pipe-like mouth-piece similar to the stone pipes which Professor Putnam has pictured and described and which when unearthed still had the mouth-pieces attached by means of asphaltum.[98] Some Indian pipes of today are fastened to the mouth-pieces by means of ligatures,[99] as was evidently the case with pipe shown in plate 12, fig. 3, and with another one of the collection (1–8625) the stem of which had been broken. A rude notch was cut into the outside of the stem to facilitate the rebinding and to give it a better hold. At any rate, the means of attaching the mouth-piece (comp. particularly figs. 1 and 4) was as inadequate as was the receptacle

[98] *l. c.*, pl. IX.

[99] Powers, *l. c.*, fig. 43, opp. p. 426.

for the tobacco at the front end. Short reed-like tobacco-pipes are particularly characteristic of the middle portion of California. A stone tobacco pipe coming from a shellmound in Visitacion Valley south of San Francisco, pictured by H. H. Bancroft,[100] is very similar to plate 12, fig. 3. The fourth one in the plate, pictured by Powers, is also analogous. Short pipes are of course also found in southern California,[101] but the longer reed-like variety is more usual. A tobacco pipe pictured by Marquis de Nadaillac and coming from the cliff dwellers[102] is somewhat similar to plate 12, fig. 2, but here the stem was so slight that there was no need of a special mouth-piece. The short pipes as well as the long ones of southern California[103] are also found in the eastern part of the United States. Several clay pipes from New Jersey[104] may be compared to them; also two objects merely classified as "pipes," but most probably tobacco pipes, from West Virginia[105] and Tennessee.[106]

10. Various Polished Stone.

In the mound were found different kinds of stones,—some isolated specimens showing good workmanship but as yet unclassified, and others, of the common kinds which were, of course, in use at the same time with the more perfect implements.

Those of the first kind were all found in stratum II. One of these is 1–8671, plate 12, figs. 12*a* and (front view) 12*b*. It is made of soft serpentine. Its shape is that of a flat cylinder of not entirely uniform height, with flat or almost imperceptibly curved ends; there is a perforation which extends inward in the form of a cone from both ends.[107] In the gentle curving-out of its peripheral surface it is particularly like ear-pegs. It is worthy of note that Moorehead shows two objects from the neigh-

[100] *l. c.*, IV, p. 711.

[101] Comp. two of Putnam's views in pl. VIII.

[102] *l. c.*, p. 256, fig. 112. The one drawn by Peet, *l. c.*, I, p. 282, shows the same object.

[103] Cf. Abbott, *l. c.*, p. 330, fig. 322, from Massachusetts.

[104] Abbott, *l. c.*, pp. 336 and 340.

[105] Fewkes, p. 128, fig. 155.

[106] Rau, Smiths. Contrib., *l. c.*, p. 44, fig. 176.

[107] As regards its form it may be compared to the objects shown by Moorehead, *l. c.*, p. 279, fig. 418, Nos. 2 (from Napa county) and 7, from North and Central California.

borhood of Stockton analogous to it in many respects and designated by him as lip-pegs,[108] and that barbed, bone spear-heads like those used on the northwest coast were found in the vicinity of Stockton, according to Mr. Meredith, in close proximity to a lip-peg[109] of the kind used on the northwest coast. The possibility, therefore, of an ethnological connection between the ancient inhabitants of the vicinity of the central California water basins and those of the north cannot well be denied.

The small object, 1–8628, plate 12, fig. 13, seems similar in size and form to the object shown in plate 12, fig. 12. This similarity is only a superficial one, aside from the difference in the material of which it is made,—burnt clay, rare in California and not carved but modeled; it is further different in the fact that its cross section is oval and that its slightly arched end is covered with marks of blows, and that the perforation is absent.

Plate 12, fig. 6, 1–8631, is of quartz-colored material, flat and tongue-shaped. It is broken off at the broad end, the lower surface is flat, the upper slightly arched, and the edge blunt. Judging from its form and the brittle nature of the material of which it is made, it must have been an ornament.

Plate 12, fig. 5, 1–8850, of chalcedony, looks like a neckless head of a bird resting on a bust-like body; the bill is linear; the eye is represented by a deep hollow. That this object is not an artifact is the conclusion suggested by the presence of a crust over the entire object from beak to eye, formed by its weathering. In relation to other products of human workmanship, such an object has worth only in so far as its shape was of undoubted significance to the inhabitants, and carefully preserved for that reason.

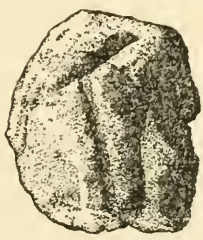
Besides this, various flat, smooth stones of chert and agate were found, one of which, 1–8849, from stratum VII, is shown in fig. 23. It is made of fine grained sand-stone, has but one smooth side and was used as a whet-stone. A thin oblong sheet of mica-slate was unearthed, but it must have been used only as an ornament.

[108] *l. c.*, p. 285, fig. 426, Nos. 3 and 5.

[109] The use of lip-pegs has never been observed in that region between Mexico and the northwest coast of North America. W. H. Dall, Public of the Bur. of Ethnology, 1881-82, III, p. 86.

Fig. 24 (1–8721 from stratum V) illustrates one of two analogous objects from the upper strata of the mound. It is a common stone with about seven groove-like lines of varying breadth and depth on the sides. Two of them form an angle which though purely accidental might seem to be ornamental. The grooves come probably from its use as a whet-stone for bone awls, etc. To this purpose the hard, sandy substance easily lent itself. Long bars could not have been fixed to this stone, since for that purpose the grooves are neither broad nor straight enough. Several drawings by Rau[110] and by Moorehead[111] may here be compared.

23



24

Fig. 23. × ⅕. Fig. 24. × ½. Stones, probably used for whetting.

b. Chipped Stones.

A great number of these were found in the mound. As regards their shape they fall into two classes, either finished implements or chips from the workshop. As regards the material of which they are made, they also fall into two large separate classes: those of the usual, light stone natural to the place such as flint, chert (in green or brown variety), horn-stone, jasper, etc., and those of obsidian (volcanic glass), which was not to be had in the immediate locality, although it was the preferred material. The classification according to material is the more important. There were found about twenty-five obsidian objects (among them a very few rough pieces or waste bits from the work-shop, the latter all small) and about 140 hewn stones of other kinds of material. Most of these were waste from the work-shop, all of

[110] Smiths. Contrib., *l. c.*, p. 304.

[111] *l. c.*, p. 338, fig. 493.

the size of implements, but relatively few (about one-fourth) complete tools.

The obsidian implements came from the Ist to the IXth strata, but most of them were found in the upper layers. Nearly three-fourths of them were taken from the three upper strata. In stratum II alone there were ten implements and one piece of obsidian in the rough. It can certainly be inferred that the great quantity of obsidian tools from II was connected with the custom of burning the dead and of casting their belongings into the flames. In addition, the great number found here shows a broader and more universal use of obsidian in the making of implements.

They are all of very simple form, such as arrow- and spear-heads,[112] spear-like points and a flat knife-like blade, made from the rough stone by polishing off bits[113] (see plate 10, figs. 11 to 16). Arrow-heads of obsidian were found only in stratum II, comp. 1–8676, plate 10, fig. 13, the blade-like knife. 1–8633, fig. 11, and the spear-like knife end, 1–8634, fig. 16, which were found there. 1–8926 from stratum VIII, fig. 15, may have been either a spear-head or a knife. Fragment 1–8536 from stratum I, fig. 12, by virtue of its two unevenly arched surfaces, and 1–8883, fig. 14 of the plate, from stratum VIII (found nineteen feet down in the tunnel between parts 8 and 9 of the shaft frame) on account of its long peg-like lower end, may be parts of knife-like implements. They were fastened on rod-like shafts similar to the fine-handled knives of southern California shown by Professor Putnam and which are in an excellent state of preservation.

From a technical standpoint, it is worthy of note that implements of such perfect workmanship as figs. 12[114] and 13 were not found among the obsidian implements of the lower strata of the mound. A proportional decrease in obsidian implements of good workmanship can be noted as one approaches the lowest strata.

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[112] For the use of spears in California comp. Powers, *l. c.*, pp. 221, 321, etc.

[113] No decorative or fantastic shapes were found among the obsidian objects as elsewhere in central California. Moorehead has shown some of these in *l. c.*, p. 262. A curved hook-like object was found in the shellmound at Ellis Landing.

[114] Moorehead, *l. c.*, p. 265.

In northern California obsidian is found near Mt. Shasta, on the north side of Mt. St. Helena and in pieces to the size of an ostrich egg in Napa Valley.[115] It is a product of volcanic eruptions, phenomena which were of frequent occurrence during the tertiary period. The material of which the implements found about the bay in all the shellmounds were made must have come from one of the above-named sources through trading. The small number of such implements found in the shellmounds is probably the result of the comparative rarity of the obsidian in this locality and the resulting care with which it was hoarded.

It is to be inferred that at no period was obsidian exclusively the material used for chipped stone implements, since workshop waste composed of materials found in the neighborhood has been discovered up to stratum II. Since, however, waste and no finished implements of local materials have been found above stratum V, the instances of the use of such must have been relatively isolated in the upper strata. Toward the lower strata, from about the VIIth but practically from the VIIIth on, there is a great increase in workshop waste. Stratum V is the uppermost one out of which one or two single objects (among them 1–8756, plate 6, fig. 21) may be considered finished implements. Of the thirty-nine implement-like objects obtained in excavating, only one is of unusual workmanship, an arrow-head of chert, 1–8815, plate 6, fig. 19, which comes from stratum VII, at the lowest part of cut C. The extraordinary accumulation of objects of chipped stone which can be termed implements begins with stratum VIII and continues down to the lowest stratum X. A considerable number of these is shown in plate 6. It is, however, remarkable that of these not one shows in its workmanship complete mastery in the handling of the material. The implement which, though still crude, shows the next best workmanship is the leaf-like point of crystalline rock, 1–8929, plate 6, fig. 20, from stratum VIII, found at the innermost end of the gallery.[116] All of the remaining implement-like objects of chipped stone bear the marks of crudity as do all of those that come from strata IX and X. It is

[115] Cf. Rau, Smiths. Rep., 1874, p. 358.

[116] It is similar in form to a point shown by Abbott, *l. c.*, p. 92, fig. 67, found in New Jersey, which he called a knife (p. 90).

very noticeable that because of this crudity in most of them, the line between implement and waste is very vague. It was therefore difficult to decide in the case of many objects whether they were to be regarded as tools at all. On the other hand, it is probable that a number of pieces included under rubbish may have really served as tools.[117]

Resulting from the discovery of obsidian, plate 10, fig. 15, chipped stones of good workmanship were found as far down as the upper part of stratum VIII. It is extremely doubtful whether they appeared at all in the strata below this. The objects made of material from the vicinity of the mound were certainly made during its settlement. A characteristic mark of the uniform crudity of all of these tools made of local materials and found in the lower strata is that they all are worked from but one side and that the elaboration of that side is accomplished by but a very few strokes. The only exception to this is the point, from stratum VII, pl. 6, fig. 19, which as to technique belongs in another place. Pl. 6, fig. 18, 1–9012, shows a ridge-like elevation on its lower side, thus forming an unimportant and superficial exception. The point, 1–8929, pl. 6, fig. 20, is also entirely even on its under side. In this they have a peculiarity characteristic of the well-known "turtle-backs."[118] This latter kind which in the eastern states of the United States has been found typical of the implements of the palaeolithic age is to be recognized in two objects in our collection, 1–9095, of green chert, pl. 6, fig. 2, from stratum X, and 1–9007 of a crystalline substance, pl. 6, fig. 1, from stratum IX. The first of these is without a doubt an implement, and the second is probably one. The palaeolithic turtle-backs of the East are unmistakably to be differentiated from the two objects under question in the material of which they are composed, which is argillite. In any case, however, the presence of these two objects proves that primordial species of stone implements existed into the neolithic period (for the mound rests on alluvial soil) and they may give ground for the estab-

[117] Comp. a similar remark in Abbott, *l. c.*, p. 93, concerning the doubtful nature of chipped stones as implements; from the stones in their vicinity they were conjectured to be implements.

[118] Cf. Abbott, *l. c.*, pp. 492 ff., and the same, Report of the Peabody Museum, 1876 to 1879, II, p. 33 ff.

lishing of the period from which such implements date, which is even farther back than that. The conical piece of jasper brought to a point by chipping, 1–8851, pl. 6, fig. 3, from stratum VII*a*, illustrates how implements were made by chipping from larger pieces of stone, and may even be itself a tool. It cannot be stated indisputably that the greater number of the common forms of chipped stones shown on pl. 6 were obsolete among the latter inhabitants of the mound. But it must be noted that the greater number and the most characteristic of them do not appear in the upper strata. We may surmise that as far as they did occur among the founders of the upper strata they had a better form. In addition to the pointed (pl. 6, figs. 19 to 20) and knife-like implements (fig. 21) the following important types are represented.

1. Long scrapers sharpened on one side, 1–9012, fig. 18, from stratum IX, and 1–9093, fig. 17, from stratum X.

2. Chisel-like tools terminating in front in a straight sharp edge. 1–8857, fig. 14, from stratum VII*a*, and 1–9080, fig. 15, from stratum X.

3. Scrapers, more or less rounded off or oval. 1–9023, fig. 8, from stratum IX, 1–9053, fig. 9, from stratum IX, 1–9085, fig. 10, from stratum X.[119]

In a like manner the following irregularly shaped objects might have been used as scrapers.

1–9043, fig. 7, from stratum IX.

1–8966, fig. 11, from stratum VIII or IX.

1–9012, fig. 12, from stratum IX.

1–9040, fig. 13, from stratum IX.[120]

4. Oval stones with high "turtle-back" backs with the encircling edges sharpened, probably too large for use as the usual scrapers:

1–9007, fig. 1, and 1–9095, fig. 2 .

5. Drills or awl-like, pointed stones, with a more or less thick base.

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[119] A hide-scraper fastened into a wooden shaft from the Thuswap Indians in British Columbia in the Jessup collection shown by Moorehead, *l. c.*, p. 255, fig. 388.

[120] Pictures of scrapers, see Abbott, *l. c.*, pp. 12 to 138.

1–8961, fig. 6, from stratum VIII or IX.

1–9005, fig. 5, from stratum IX.

1–9031, fig. 4, from stratum IX.

Instruments like the last have been found in many parts of the United States.[121] Several of these bear a great resemblance to those here shown, one such is pictured by Rau[122] from Santa Cruz Island, and one of like origin by Putnam,[123] one from Santa Rosa Island.[124] Traces of asphaltum found on the broad base of many similar ones would point to the fact of their once having been fastened to a shaft.[125]

B. Utensils of bone, horn, and the teeth of animals.

Implements of Bone.

Artifacts of animal derivation appear in great numbers and in a great variety of form among the objects recovered in excavating. This diversity in form is of course partly the result of the different kinds of bone used in their manufacture, partly of their varied manipulation, and partly of the uses to which they were put. There are all grades of elaboration from the most common splinter of bone to the tool whose shape is almost entirely different from that of the bone employed. All the objects found, however, may be reduced to the principal types of bone instruments which have been found in the United States under the most varying circumstances. In addition to awls, needles and paper-cutter-like knives of bone, there are instruments of horn used principally for chiseling and instruments of a secondary nature. They were the usual tools used in making clothes,[126] in weaving baskets,[127] etc., not to mention several subordinate uses to which they were put.

1. Awl-like tools.

This is a large class containing more than 100 objects having

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[121] Comp. Moorehead, *l. c.*, pp. 146, 170, 308; Abbott, *l. c.*, Chap. VII, pp. 97 to 119.

[122] Smiths. Contrib., *l. c.*, p. 90, fig. 318.

[123] F. W. Putnam, *l. c.*, p. 68, fig. 15.

[124] Moorehead, *l. c.*, p. 340, fig. 372, fig. 1.

[125] Rau, *l. c.*, p. 91, after P. Schumacher.

[126] Schoolcraft called them "moccasin-needles."

[127] The broom-binders of Mark Brandenburg to this day use bone awls, see Ranke, *l. c.*, II, p. 509.

various secondary forms and it is the most conspicuous class of bone instruments. They may be classified as follows:

a. Common awls with a good point.

These comprise more than 100 perfect and fragmentary specimens. They were scattered through almost all the strata in the following way:

Stratum I—8 objects.
Stratum II—61 objects.
Stratum III—8 objects.
Stratum IV—11 objects.
Stratum V—3 objects.
Stratum VI— — objects.
Stratum VII-VIII—5 objects.
Stratum IX—5 objects.
Stratum X—4 objects.

The remarkable preponderance in stratum II is probably again the result of the practice of cremation of bodies.

When one remembers that awls were the principal tools used in making baskets and that baskets took the place of pottery in the household of the California Indians, one will not wonder at their great number.

Their shapes vary. Four of them are shown in plate 9, figs. 1 to 4. Fig. 1, from stratum I, gives the type by far the most common in the 3 or 4 upper strata; the other three, fig. 2, 1–8686, from stratum IV, fig. 3, 1–8897, from VIII, fig. 4, 1–8972, from IX, give examples of the many secondary forms and illustrate the diversity of form occurring in the lower strata. Although fig. 4, as regards its shape, reminds us of the type of the tool of the upper strata (cf. fig. 1), not a single implement was found in the lower strata that was the exact counterpart of those in the upper. Manifestly it was the inhabitants of the upper strata who developed and established the latter form. Its distinctive feature is this, that only one side of the bone (mostly tibia of deer) is used, that a foot-like portion of the joint is left, and that the awl is sharpened and well finished off on all sides, even to the inner channel. Usually there is a slight bulging out in the middle of the tool which increases its strength.

The characteristic feature of pl. 9, fig. 2, is that only the shaft of the bone is open, the joint being left intact. In pl. 9, figs. 3

and 4, the foot-like supports are missing; whether originally they were there or not is a question. They seem to have been missing from the very beginning, at least the one shown in pl. 9, fig. 3. The whole shape of the instrument is crude. In several awl-like implements of the lower strata, as in text-fig. 25, 1–8797, from stratum VII, the canal in the bone is not even opened, but kept intact through the whole instrument.[128]

b. Blunt awl-like implements.

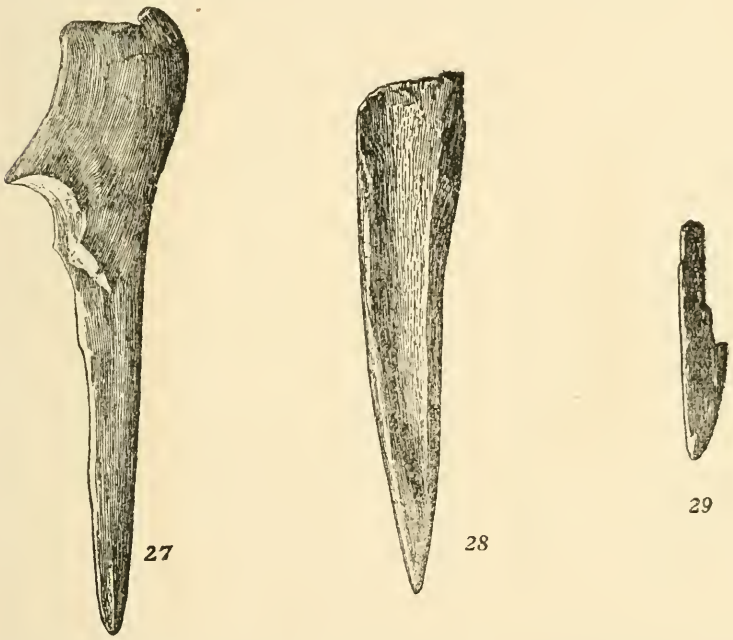
25

26

Fig. 25. × ½. A bone, probably used for an awl. Fig. 26. × ½. Bone implement of unknown use.

[128] Numbers of awl-like bone implements of this kind coming from the United States have been depicted. For those from California, see H. H. Bancroft, Native Races, IV, p. 711, No. 1 (the other so-called tool, No. 2, is a natural bone without value as a tool); Moorehead, *l. c.*, p. 271, fig. 410; F. W. Putnam, Rep. of U. S. Geogr. Survey, *l. c.*, pl. XI, figs. 13 to 15 and 19; p. 227, fig. 104; Nadaillac, *l. c.*, p. 49, fig. 15 (not very useful); from the southern states, for instance, Ch. C. Jones, Antiquities of the Southern Indians, 1873, pl. XVI, fig. 1; Moorehead, *l. c.*, p. 142; Chas. Rau, Smiths. Contrib., No. 287, p. 64, fig. 238 (Kentucky, Tennessee); from shellmounds of New England; Wyman, Am. Naturalist, I, pl. 14, fig. 5, and pl. 15, fig. 9 (both repeated in Abbott, *l. c.*, p. 213, figs. 199 and 202), from New York; Schoolcraft Archives of Aborig. Knowledge, 1860, II, pl. 49, fig. 3, with p. 90, from the Aleutian Islands, Chas. Rau, *l. c.*, fig. 236.

The absence of points indicates a somewhat different use to which such instruments were put. In addition to this feature there is very frequently a peculiar curve which, while it is the natural shape of the bone, must have been chosen purposely,—for instance, 1–8692, pl. 9, fig. 5, from IV, and 1–8829, text-fig. 26, from stratum VII*a*. The bone of front leg of a stag is the original form of the partly awl-shaped partly paper-cutter-like implement, 1–8579, text-fig. 27, from stratum II. A similar one from the southern part of the United States has been observed.[129]



Figs. 27 and 28. × ½. Bones probably used as awls. Fig. 29. × ½. Bone of "paper-cutter" type.

c. Flat Awl-like Implements.

These represent a large and important class of implements which occur in numbers in several of the lower strata (V and IX), although really only in fragments; cf. 1–8985, pl. 9, fig. 6, from stratum V. They are curved sideways, and well-pointed in spite of their otherwise flat character. The interior reticulate structure of the natural bone is retained on one side of the implement.

[129] Moorehead, *l. c.*, p. 142; comp. also Ch. Rau, Smiths. Contrib., No. 287, XXII, p. 64, fig. 237 (from Kentucky).

Fig. 28, 1–8541, from stratum II, has a peculiar shape; it is broad, in the form of a channel and pointed. One of the edges of the channel seems to be worn smooth through usage. The back end is broken off.

2. Needle-like Implements.

They differ from the awl-like implements in that they are intended not only to pierce an article but also to pass through it. In this class there are also secondary shapes.

a. Straight needles without perforation.

1–8895, pl. 9, fig. 8, found twenty-seven feet beneath the surface in stratum VIII, may be taken as the prevailing type. The needle is a thin, pointed instrument, oval in cross section, blunt at the back end, well finished throughout. To this class also belongs a number of fragments found in different strata up to the VIIIth.

b. Curved needles.

1–8901, pl. 9, fig. 9, from stratum VIII, represents this type. The needle is very slender and thin and of good workmanship. Unfortunately it is broken off at the smoth posterior end.[130]

c. Needles with "eyes."

We have also only one specimen of this type, 1–8735, pl. 9, fig. 10, from stratum V. It is straight, round in cross section and tapering at the perforated end.[131] The bluntness of the point must be the result of use.

d. Long crooked needles.

1–8831, pl. 9, fig. 7, a well preserved and seemingly perfect specimen, was found in stratum VII*a*, in the tunnel, from eleven to fourteen feet below the surface. It consists of a long, thin rib pointed at the stronger end, thereby exposing the canal within.[132]

[130] Comp. the objects found in a shellmound in New England, Am. Naturalist, 1; pl. 15, fig. 17; it, however, is broader.

[131] A similar needle from a mound in Ohio has been shown by C. L. Metz and by F. W. Putnam, Rep. of the Peabody Museum, 1880 to 1886, III, p. 452. The Point Barrow Eskimos use a similar one (J. Murdock, IXth Ann. Rep. of the Bur. of Ethnology, 1887-88, p. 318, fig. 325).

[132] It reminds one somewhat (in that it is curved and pointed) of an instrument designated, and that manifestly wrongly, by Moorehead as a hairpin (see Moorehead, *l. c.*, p. 271, fig. 410, under No. 4). Jeanne Carr tells of needles made usually of the strong wing bones of the hawk, used to keep the strands in place when the basket-weaver left his work. These were handed down from mother to daughter generation after generation and regarded as valuable possessions. (The Californian, 1892, No. 5, p. 603.)

Among those found there is also a needle of fish bone and likewise one made from the spine of a stingray.

3. Rough awl-like implements of the lower strata.

We have chosen to discuss a number of implements from the lower strata under this separate head. Although some of these were probably used as awls, yet along with others with which they form a small group they cannot easily be considered with the other implements of this class. Plate 7, which represents typical bone implements of the lower layers, shows the greater number of these peculiar shapes in figs. 1 to 10. Altogether about fourteen of these awl-like implements were found in stratum VIII, five in stratum IX and four in stratum X. When one considers that from layers IX and X, only small sections were explored, the relative number of these implements must excite some interest. The awl-like and needle-like objects of pl. 9, although but little worked, are yet characterized by a definite fundamental form, different from that shown in the objects represented in pl. 7, figs. 1 to 10.[133] They represent simply bone splinters of the most varied forms such as would be made by accident. To be sure, there were isolated bone splinters in other places in the excavation, probably used as implements, as would naturally occur in a shellmound. In all of these latter cases, however, the character of the objects was, owing to the form of the bones and to the accidental or typical intention of their use, completely different. The objects shown in figs. 1 to 10 of this plate are made of fragments of somewhat thick long bones. All of them have been much used and the upper ends are strongly rounded and worn. Their use was evidently intentional both with reference to their more general and their typical uses. They do not belong to a peculiar type of implements because it is evident from their form that they were used for many purposes.

Some, as figs. 6, 7, and 8, 1–8919, 1–8918 (VIII), 1–8979 (IX), have an awl-like pointed form and may accordingly have been used as such an implement. Others, as figs. 1, 3, 4, and 10, 1–8983 (VIII), 1–9069 (X), 1–9068 (X), 1–9072 (X), although in general awl-like, are blunter and can hardly have been put to

[133] The principal smaller forms figured from southern California by Putnam, *l. c.*, Pl. IX, figs. 16-17.

the same use as these forms just mentioned. Objects like 1–8980, pl. 7, fig. 5; 1–8996, pl. 7, fig. 9, and possibly also 1–8871, pl. 7, fig. 2, have such broad and blunt ends that for them characterization as "awl-like" would be entirely unsuitable and their use must be explained in some other way. The tie that holds them together is, therefore, in no way that of similar use but rather of analogous origin. They comprise a large number of implements having different uses. What is common to them is the similarity of the way in which they were obtained. Their use was determined by the chance form which they thereby received. There is before us then a class of the most primitive ethnological implements of which we have knowledge, in which, as in the oldest known implement of the human period, the natural form of the object determines the use, rather than the use the individual form.

4. Implements of the shape of paper-cutters.

It is natural that in so large a number of bone implements this shape also should be represented. Five belonging to two different types have already been discussed under the grave finds. Altogether the amount of material of this character obtained from the upper strata of the mound is remarkably small. Only a small number of fragments were found, of which only a fragment of the point, 1–8803, from stratum VIII is represented in fig. 29.

In the deeper strata the case was entirely different. There are from these layers no perfect implements, only fragments, but their number is in proportion to what one would expect, or even greater. Some of these show a variety of form and a degree of ornamentation which was hardly to be expected among the finds of the mound in general and least of all among the specimens obtained from the lower strata. Little as the well formed implements, which the fragments figured in pl. 7, figs. 11-17, represent, appear to resemble the rough awl-like implements on the same plate and which have been derived from the same strata, there is yet no doubt possible that the two classes of implements must have been used by the same people.

We have therefore the task, instead of denying the contrast, of suggesting some solution for it.

These paper-cutter like implements have a moderate width and a thickness of only one-thirty-second to one-sixteenth of an inch. They are well worked in all cases. The objects shown in fig. 12, 1–8989 (IX), fig. 14, 1–8987 (IX), fig. 15, 1–8920 (VIII), fig. 13, 1–8988 (IX), of plate 7 show artistic forms differing from the simpler types of implements. Perforation, which in the bone implements of the mound is very infrequent, is in these implements alone found four times on the lower end. The notch on the lower end of pl. 7, fig. 14, probably the remnant of a circular section, is very artistic and one notices also curved lines on the surface about it. These show the geometric accuracy with which this work was carried out. 1–8986, pl. 7, fig. 16, from stratum IX, is the only piece of bone among all those recovered from the mound which has been engraved with geometric figures.

Out of the strongly varying yet constantly artistic characters of these fragments we are justified in drawing the conclusion that a much greater variety of implements of this form was used by these people. The variations seem to have been influenced largely by personal taste.

1–8875, fig. 11, represents a small fine point of a well formed small paper-cutter-like implement.

1–8989, fig. 12, stratum IX, is a quadrate piece of bone cut out of a "paper-cutter" and was possibly used in play.

1–8988, fig. 13, stratum IX, is the lower end of a "paper-cutter" with parallel sides and obliquely truncated at the lower end with a remarkably perfect perforation.

1–8987, fig. 14, stratum IX, is the lower part of a thin "paper-cutter" with a semi-circular notch. The base shows broken surfaces next the notch.

1–8920, fig. 15, stratum VIII, the lower, triangular part of a "paper-cutter," which has been very broad and thin, has a small perforation.

1–8986, fig. 16, stratum IX, the middle fragment of a well-worked "paper-cutter" ornamented with geometric figures.

1–8984, fig. 17, stratum IX, is the oblong upper part of a very thin, well-worked "paper-cutter" with a perforation. The upper part is broken off.

At this place there should probably be mentioned also the

small bar of bone, 1–8975, fig. 18, stratum IX, as it also comes from this stratum. This is likewise an uncommon form of implement. It is small and well worked, although not of the paper-cutter type. It is oval in cross section and has a small paper-cutter-like lower end which shows that it was fastened to some other object. Its upper end is broken.

5. Pointed Implements.

In the middle strata of the mound there were found about eight pointed bones, of which the types are figured in pl. 9, figs. 11–16.

1–8869, pl. 9, fig. 11, stratum VII, is 2⅛ inches long, oval in cross section and having an inferiorly constricted neck. There is a small hook on the lower end of the broad side. A small fracture on the opposite side appears to indicate that there were originally two such hooks.

1–8868, fig. 12, stratum VIII, is two inches long. This specimen is in general similar to the one just mentioned. There is only one hook at the lower end. The side opposite is without a hook and is unbroken. Similar is 1–8738, from stratum V. An analogous object is figured by Moorehead, page 273, fig. 412, No. 3, from Stockton Channel.

1–8916, fig. 13, stratum VIII, 2 inches long, is similar to the last with the differences that the small broad, flat hook points toward the broad side, and that the pointed end has been smoothed by use. On this end there are also small traces of asphaltum which indicate that a cord had sometime been wound about it to fasten it to some other object.

1–8917, fig. 14, stratum VII*a* or VIII, 1⅞₁₆ inches long with a rounded cross section, is slightly curved and gradually narrows towards the lower point. The convex side shows a slight flattening.

1–8870, fig. 15, stratum VII*a* or VIII, is 1½ inches long, but the lower end is incomplete. The cross section is oval to flat; it shows on the broad side a sloping groove.

1–8694, fig. 16, stratum IV, an implement 2³⁄₁₆ inches long, is typically knife-like in its form in so far as it has a broad blade-like part. It is sharp on one side, blunt on the other and rounded at the upper end. It is bent well backward. At the lower end it

runs out into a small neck-like portion which is extended in the same line with the back of the implement and is broadened at the base.

The objects already described and shown in figs. 11, 13, 14, 15, and 16 of plate 9 represent the principal types. Among these the knife-like object, fig. 16, is, judging from its shape, evidently to be separated from the others.[134] Numerous other knives of obsidian occur in addition to this one of bone.

Of the remaining, fig. 14 represents a typical arrow point made of bone such as are used in various parts of the world, *e.g.*, in South America. The convex, slightly flattened side was laid against the slightly truncated upper end of the shaft of the arrow and was fastened to it by numerous coils of cord. The figure of a similar arrow point from the Swiss Pile Dwellings is given in Ranke's work, Vol. II, pp. 5–19, fig. 11. This shows very well the manner of attachment.

The similarity of the remaining bone points, figs. 11, 13, 14, 15, is so significant that a similar use is to be ascribed to them. That they were used as fishhooks, which might be conjectured, there appears to be less evidence. It is worth considering that Mr. Meredith found on the breast of a single skeleton 51 objects of the form shown in pl. 9, fig. 14. In another case 28 such objects were found.[135] In the first case, with the skeleton in addition to these were found two long spear spoints with barbs such as are used on the northwest coast of America. A large number of objects from one grave and the association with other analogous objects supports very strongly the idea that the pointed bones were used for the points of arrows. The neck of these points was the portion about which the cord was wound and about this was laid a small quantity of asphaltum to hold the cord in place, while the hooks had the object of preventing the cord from sliding off from the neck. The form of the hooks varies but slightly. This suggests the prominent hooks at the base of the

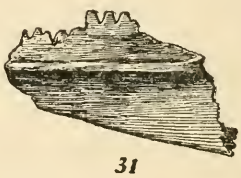
[134] Compare knife-like "hide-scrapers" of bone used by the Eskimo of Behring Straits and figured by E. W. Nelson in the 18th Annual Report of the Bureau of Ethnology, 1896-97, Part I, pl. 50, figs. 3-6.

[135] In Moorehead, *l. c.*, p. 272. Two similar objects from South America are figured by F. W. Putnam, *l. c.*, pl. 11, figs. 10, 11, and are described (p. 227) as fishhooks.

arrow points of stone. In a certain way these arrow points may possibly be considered as a middle form between long bone points provided with barbs, such as were used by the Eskimo, and the Indian arrow points of stone. In this connection it is worth noting that Mr. Meredith finds them in association with such bone points (also with a lip-plug such as are used on the northwest coast of America). The form of the Indian stone arrow-heads might have been imitated in the North in other materials.

That the analogy with the more northerly races is not limited to the burial layers of the mound from which the pointed implements, pl. 9, figs. 11, 15, were found is indicated by the object, pl. 7, fig. 12, which was found in the cremation layer, No. 2.

30



31

Figs. 30 and 31. × ½. Notched bones perhaps used in net-making or weaving.

6. Saw-like notched bones.

The excavations furnish twelve objects of this type of implement, of which perhaps half were from stratum II. The remainder were found from the lower strata up to the eighth. Quite a number of the objects from stratum II were calcined, an evidence that they were deemed of value in life since they were burned with the dead.

The best preserved type of this implement, of which in most cases only small fragments were found, is shown in 1–8898, pl. 9, fig. 17, stratum VIII.

Nearly all of these objects have a stereotyped form, being made from the shoulder blade of some large mammal, probably the deer. One, however, seems to have been made from a bird bone (1–8900, fig. 30, stratum VIII). On the specimen shown in pl. 9, fig. 17, about half of the length is taken up by the rounded handle, using the ridge-like end of the bone for this purpose. The other end of the object is incomplete, but according to the

form in other specimens it was probably cut off squarely at the end. At any rate only a small piece of the implement is missing since the teeth cut into the thin convex margin of the bone are complete to the number of 15. The ridge-like edge runs next to the row of teeth, giving the implement greater firmness. The teeth vary considerably in different objects in size, in form, and in regularity (compare 1–8573, fig. 31, from stratum II). They also vary in degree of wear, which so far as observed is sometimes seen on the edge and sometimes in the spaces between the teeth. On one specimen the opposite edges of the bone are similarly toothed, although one side of the bone was quite thick. A smoothing or polishing of the object is never to be noticed, excepting on the under side.

Similar objects have frequently been found in California. Single fragments are figured by Moorehead.[136] As similar as these objects are to saws, it is probable that they were not used as such. The name "sachos" given to these implements by the Napa Indians, who possibly did not know their former use, is not to be taken as the slightest support for the idea that they were actual saws. In the first place it is hardly necessary to mention that the concept "saw" is missing among the Indians. The form of these objects and the general state of wear as already described shows that they were not and could not have been used as saws. It is remarkable enough that saw-like implements made of bone have a distribution much more extended than the Californian region. Since these occurrences are mostly local and entirely independent of each other, these implements must in their production have served certain practical aims. Why, however, saws made of bone should have such a wide distribution it is difficult to understand.

An analogous implement has been found in a shellmound in Massachusetts and figured by J. Wyman. He also in his description has shown that judging from the width of this implement it could not have been used as a saw.[138]

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[136] Moorehead, *l. c.*, p. 236, fig. 363.

[138] The stone points with saw-like teeth on the edge do not represent technically such an implement as a saw since the toothing is only a result of the method of reproduction.

Another saw-like toothed bone implement was found in the cave dwellings in Franconia (Bavaria), which were inhabited in the early neolithic period. This has been described by Ranke as probably used in weaving.[139]

An implement having almost identical form as this just described above was figured by J. Murdock. This object was obtained from the Pt. Barrow Eskimo and was made of the shoulder blade of a reindeer. He received it as a model of a saw said to have been used before the introduction of iron.

After having made inquiries for the primitive form of the implement, this specimen doubtless was made for him.[140] His paper also contains a figure of another saw-like implement, of about twice the size of the first, made of antler. There was with this a kind of shuttle and a form of weaver's sword with the statement that these three implements had been used in weaving feather girdles. In watching the process of making these belts he had, however, not seen any of these three implements.[141] In the opinion of the writer there is no reason to doubt materially the accuracy of the statements concerning the use of these implements by the Eskimo. It therefore contains the key to the understanding of all the remaining forms of this type of saw-like implements found in the northern region. And this explanation may be extended to the wrongly determined Californian bone saws. In our opinion the bone implement first figured by J. Murdock shows simply that the Eskimo remembered having had such an implement and that they gave to him the impression that it had been used in the way in which the investigator was inclined to think it ought to have been used. It appears that Ranke was on the right track when he supposed the Frankish bone implement to have been used in some processes of weaving. In like manner all of the Californian bone saws agree thoroughly with this supposed use.[142] In California many valuable feather girdles have been made, in the weaving of which these bone implements may

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[139] Am. Naturalist, 1868, Vol. I, pl. 15, fig. 15, 583.

[140] Der Mensch, II, p. 558-560.

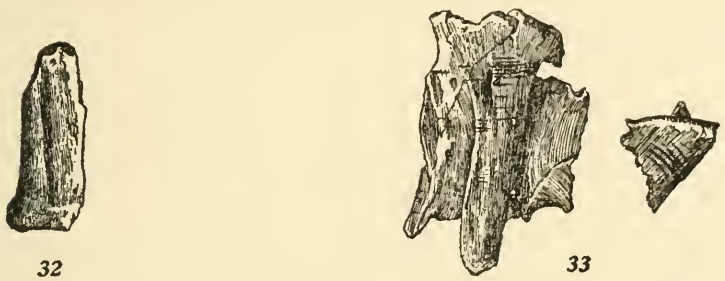
[141] Ninth Annual Report of the Bureau of Ethnology, 1887-88, p. 175, fig. 147.

[142] *l. c.*, p. 317, fig. 323.

have been used.[143] The exact mode of their use is not yet determined, but it is to be hoped, however, that even this may some time or other be discovered.

7. Various Implements and Objects of Bone.

It naturally occurs that in a shellmound in which so many implements of bone have been preserved there would be a number of bone objects the use of which can only be imperfectly determined. These implements are in part possibly only attempts to work bone, in part they are actually implements which had a use somewhat different from that of the other forms and a use for which the character of the material especially fitted them.



Figs. 32 and 33. × ½. Bone artifacts of unknown use.

Many fragments of bone show only a few cuts or marks as indications that they were worked. In one case, 1–8527, fig. 32, stratum IX, the marks which vary somewhat from those in the other strata may represent an implement of the paper-cutter type. The point is in this case calcined, as is also true of many other implements. This is evidently done intentionally, possibly in order to work the bone more easily. Other common bone fragments look as if they had occasionally been used as implements when they happened to have the right form, and that they were not intentionally worked into this shape. Still other bone fragments show knife-like incisions on the other edges, as, for ex-

[143] Recently a great deal has been written about the relation of widely separated peoples to each other. And this relationship has usually followed definite geographic lines. It is, however, worth while to notice the great similarity between the implements of eastern and western United States, and those of the caves of Switzerland and of the Arctic region. Many implements of similar type and use are to be found in these regions, implements which are not discovered in any other portion of the world.

ample, that shown in fig. 33, 1–8877, stratum VII*a*. They are probably not to be considered as marks of dog's teeth, as which these could also be determined, for they are generally very numerous in one place or else they show exceeding regularity as if made intentionally.

The shellmound dwellers did not fail to notice the peculiar character of the tubular bones, which when cut into sections are easily made into small receptacles, similar to the cane plant, which is used in a similar manner by the inhabitants of tropical regions (for instance by the ancient Peruvians). Many such small objects with differing proportions were found, two of which are shown in fig. 34, 1–8922, stratum VIII; and fig. 35, 1–9076, stratum X.

Implements of Antler.

For many kinds of implements antler is particularly valuable on account of its hardness. For this reason a number of implements of this character have been found in the shellmound; they are, however, not so numerous as those of bone. They are usually made of deer or elk antler.

1. Chisel-like Implements.

Of these there are two principal types.

a. Actual chisels.

About half of the objects of antler are to be considered as complete implements. These are shown in pl. 8, figs. 2*a* and 2*b*, 1–8892, stratum VIII; figs. 3*a* and 3*b*, 1–8821, from stratum VII*a*, represent the two subspecies of the same, *viz.*, broad and narrow chisels. The main difference between the two is simply one of size and proportion.

The broad chisels are represented by about ten objects, which belong to the middle and lower strata of the mound only, down to the Xth stratum. Whether this is accidental or caused by other reasons remains undecided. These objects are from four and one-half to five and one-half inches long, to one and three-fourths inches broad, and even as thick as one and one-quarter inches. Oval in cross section, they slightly diminish toward the lower end. Frequently they pass one to two inches above the lower end into the flat, knife-like, one-sided slope, ending in a semi-circular edge about one inch broad. The sloping surface as

well as the polished sides of the implement frequently have impressions due to actual use upon hard objects. In a similar manner, the straight surface is broken by the use of a hammer which was struck upon it.

The narrow chisels are represented only by one complete specimen (pl. 8, fig. 3) and two fragments of the knife-edge. The latter were found between strata VII*a* and IX. The complete chisel is only three and nine-sixteenths inches long; while it is one and three-sixteenths inches broad at the upper end, and but seven-sixteenths of an inch thick, it nevertheless diminishes toward the lower end to a breadth of three-eighths of an inch at the knife-edge. The slope of the one side toward the latter is by far shorter than that of the broad chisel, and yet the same indications of its use with a hammer can be found. The curvature of the cross section of this implement corresponds to the natural form of the antler from which it was made.

Such chisels[144] partly took the place of an axe in woodwork among the Indians, just as, for example, this was still the case among the Hupa during the eighties of the last century,[145] in the construction of houses. The Klamaths in Oregon still make use of such chisels. The better known implements of recent times possess only the natural surface of the original antler.

It is of interest to know that implements of exactly the same kind were found in the shellmounds of the Atlantic coast, *e.g.*, in Maine.[146]

b. Chisel-like Implements of varying forms.

Implement 1–8730, pl. 8, fig. 1, found in stratum V, has a length of nine and three-fourths inches and a breadth of one and seven-eighths and one and five-sixteenth inches. It will be seen that though of greater length and breadth it is flatter than the preceding. On account of its origin from a complete antler it is curved along its length, and slightly curved in on its concave side. At the lower end of the latter it is given a straight slant

[144] A little information on this point is brought together by the writer in Mitth. der Anthrop. Ges. Wien., 1886, Vol. 16.

[145] A similar one from San Joaquin county has been illustrated by Moorehead, *l. c.*, p. 271, fig. 410, No. 2. Cf. also F. W. Putnam, *l. c.*, p. 229, figs. 106-108, wedge-like implements from southern California.

[146] Cf. Mason, Smithson. Reports, 1886, I, pl. xviii, fig. 19, with 10, 208.

for three and a quarter inches in the diameter of the breadth. Its upper end shows the same signs of use with a hammer, while the slanting surface is greatly worn on the sides. This makes it probable that the use of this tool was in many respects different from the preceding. It was possibly used as a lever.

For this also a parallel exists in the form of an apparently identical implement from the shellmounds in Maine.[147] As regards form, certain implements of the bones of cattle found in the caves of French Switzerland are similar to this object. Rauch calls them "leather-cutters" (Lederschneidemesser).[148]

2. Implements of antlers with dull, rounded ends.

Three such objects have been found. One of them is seven and one-eighth inches long, diminishing, horn-like, toward the blunt point. It came from the middle stratum of the mound. It is represented in pl. 8, fig. 7. Another is a young branch of an antler, and the third is a mere fragment. The use of these objects, which were doubtless implements, cannot be conjectured.

3. Pointed Implements.

Only one fragmentary blade exists, about one inch long.

4. Straight, truncated Implements.

Two specimens of this kind came from stratum V of the mound. They are wanting in other parts of the mound. One of them is reproduced in pl. 8, fig. 4. It diminishes, horn-like, toward the lower end. Here it is truncated abruptly, having a breadth of five-eighths inches. Unfortunately the upper end is incomplete. The other implement, 1–8722, is absolutely identical with the one just described.

The collection contains also a fragmentary bone tool, 1–9066, which was found in stratum X. It may have corresponded to the peculiar implement, reproduced by J. Wyman,[149] pl. 14, fig. 3 (with the spiral cuts at the upper end), which was found in the shellmounds of Massachusetts.

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[147] Cf. J. Wyman, *l. c.*, pl. IV, figs. 2 and 2*a* with p. 583. Ch. A. Abbott, who represents the same implement, *l. c.*, p. 211, fig. 196, says Massachusetts probably by mistake.

[148] J. Wyman, *l. c.*, pl. XIV, fig. 1, with p. 582. Cf. also Ch. A. Abbott, *l. c.*, p. 211, fig. 195. The implement is unfortunately represented in both places sidewise in an unfavorable manner.

[149] *l. c.*, II, p. 556.

Implements of Tooth.

Only one object made of tooth was found, *viz.*, 1–8736, fig. 36, in stratum V. It is a bear's tooth perforated at the root, serving the purpose of ornament or amulet, and corresponds exactly to the typical illustration of the one from New Jersey;[150] here Abbott emphasizes the fact that such ornaments were the most common among the earlier and present-day Indians.

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Figs. 34 and 35. × ½. Fragments of bones. Fig. 36. × ½. A bear-tooth ornament.

C. Implements made of shells.

The objects of this material mentioned among the grave-finds are supplemented by two implements, one of which came from the IInd, the other from the VIIIth stratum of the mound. Both are made of the haliotis shell, the material preferred for ornamental purposes by the Indians throughout the country. Recovered in different strata, they differ completely with respect to their form. Yet, owing to the scarcity of the finds we are not permitted to advance the opinion that the form of one was limited in its stratum to the complete exclusion of the other.

1–8632, fig. 37, from stratum II, is about as long as broad, but rounded off at the lower part, while the upper rim is cut off straight. The three-sixteenths inch wide perforations in one row on the upper rim served for the purpose of suspending.

[150] Cf. F. W. Putnam, *l. c.*, pl. XI, fig. 18.

1–9106, fig. 38, from stratum VIII, represents the broken edge of a larger ornamental plate which was originally triangular or of a quadrilateral shape. The edge is now trapezoidal. Two of the four sides still show the well-worked rims, ornamented with

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38

Fig. 37. × ½. Fig. 38. × ⅖. Haliotis shell ornaments.

indentations, of the original ornamental plate. The two other sides are rough surfaces of fracture.[151]

[151] Ch. A. Abbott, *l. c.*, p. 406, fig. 388.

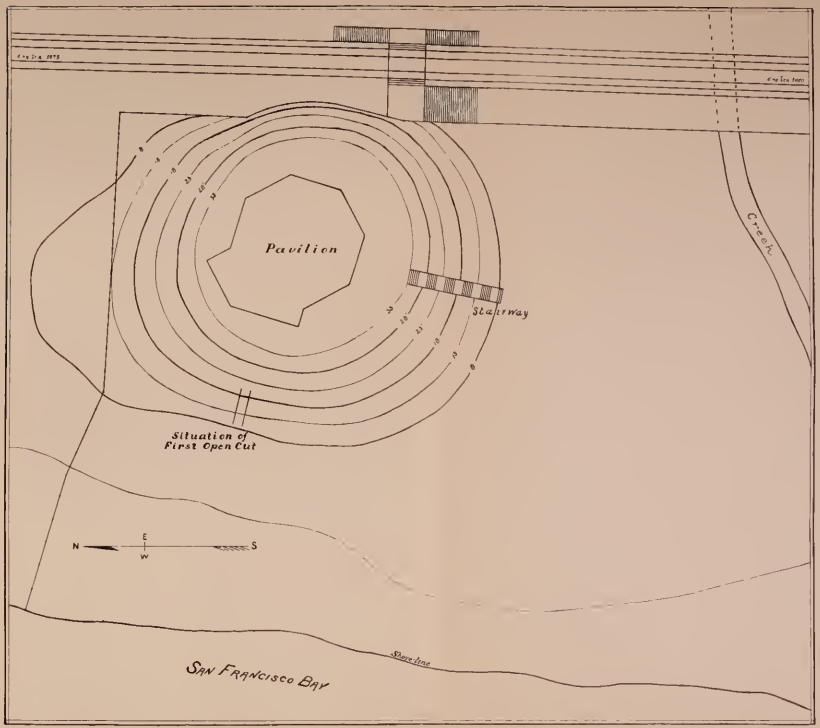
Issued June 15, 1907.

EXPLANATION OF PLATE 2.

Emeryville Shellmound seen from the Bay. The cut made in the side of the mound had been filled when the photograph was taken, but the site of the excavation is seen in the light area on the western slope.

EXPLANATION OF PLATE 3.

Topographic map of the Emeryville Shellmound. Contour intervals 5 feet. Scale: 1 inch = 60 feet.


Pavilion
Stairway
Situation of
First Open Cut
Creek
N
E
W
S
Shore line
SAN FRANCISCO BAY

EXPLANATION OF PLATE 4.

Fig. 1. Cross-section of the western foot of Emeryville Shellmound, showing the extent of the excavations. Scale: 1 inch = 19.4 feet.

1. Alluvial clay.

2. Thin gravel layer.

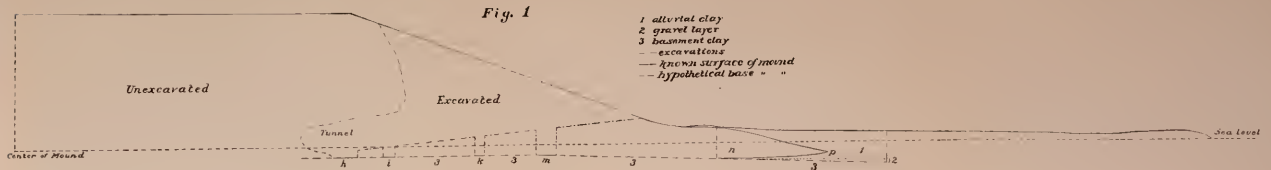
3. Basement clay, the stratum upon which the mound and the gravel layer rest.

Fig. 2. Cross-section through the principal excavated portion of the western foot of the Emeryville Shellmound, illustrating the stratification of the deposits. Scale: 1 inch = 6.46 feet.

I-X, Recognized strata of the mound.

A, B, C. Sections of the excavation designated in text.

Fig. 1


1 alluvial clay
2 gravel layer
3 basement clay
excavations
known surface of mound
hypothetical base " "
Unexcavated
Excavated
Tunnel
Center of Mound
Sea Level
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j
k
l
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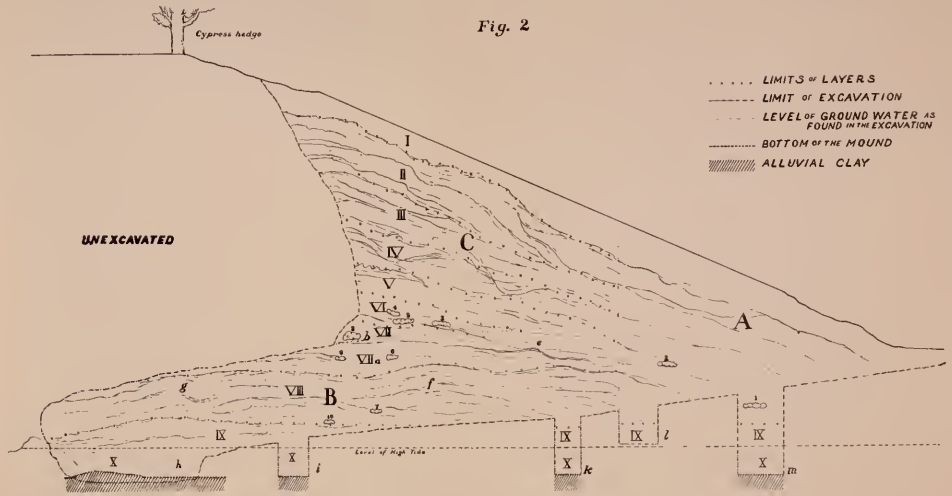
n
p
q
1/2

Fig. 2


Cypress hedge
LIMITS OF LAYERS
LIMIT OF EXCAVATION
LEVEL OF GROUND WATER AS FOUND IN THE EXCAVATION
BOTTOM OF THE MOUND
ALLUVIAL CLAY
UNEXCAVATED
I
II
III
IV
V
VI
VII
VIIa
VIII
IX
X
A
B
C
Level of High Tide
a
b
c
d
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f
g
h
i
k
l
m

EXPLANATION OF PLATE 5.

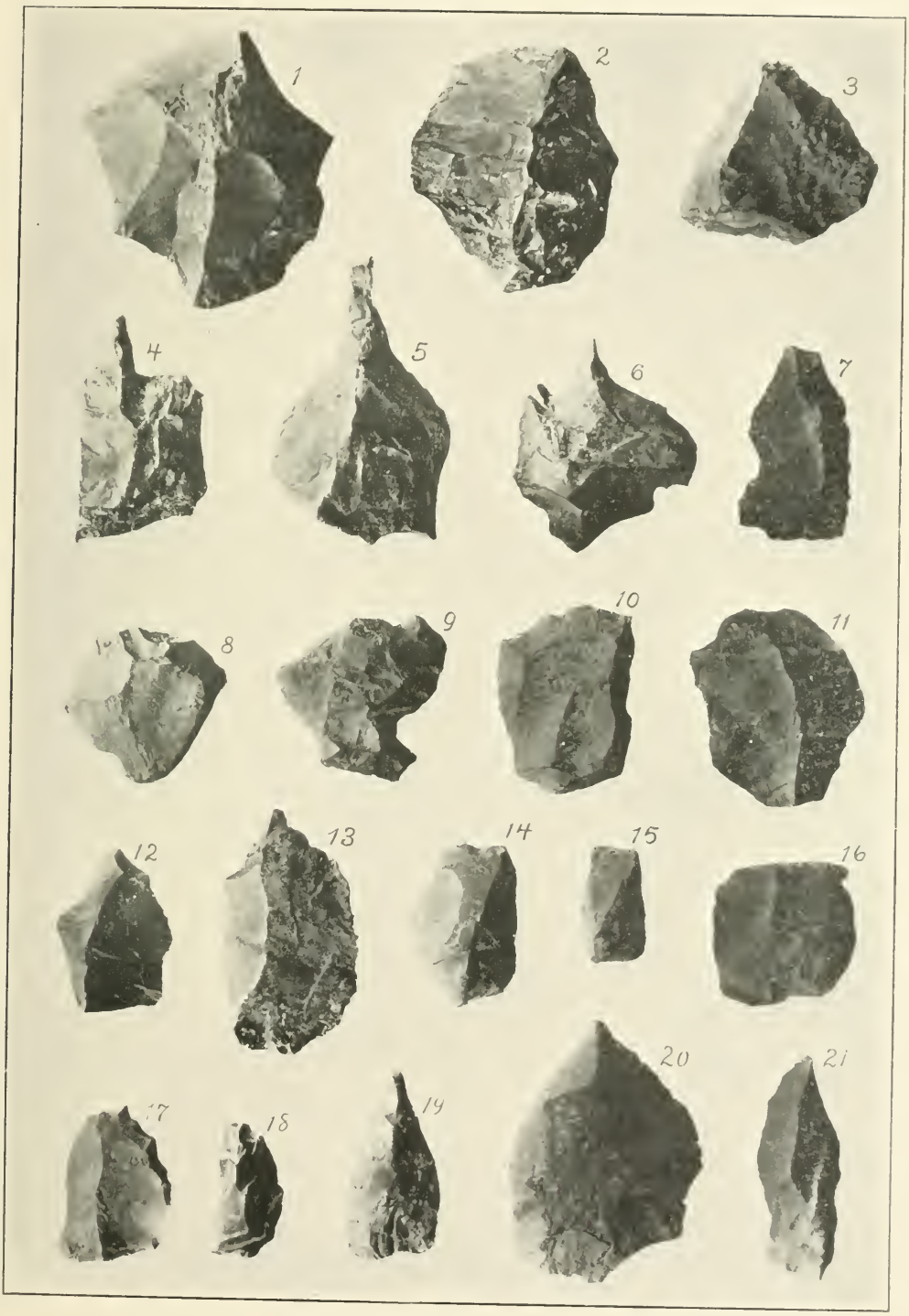
The open cut on the western side of the Emeryville Shellmound.

EXPLANATION OF PLATE 6.

Figs. 1-21. Flaked cherts principally from the lower layers of the mound. Some of these, as represented by figs. 4, 5, 6, 11, 19, and 20, are possibly finished implements. The others are perhaps in part rejects, but all were probably used to some extent. $\times \frac{6}{10}$.

Following are the accession numbers of the specimens, as catalogued in the museum of the Department of Anthropology.

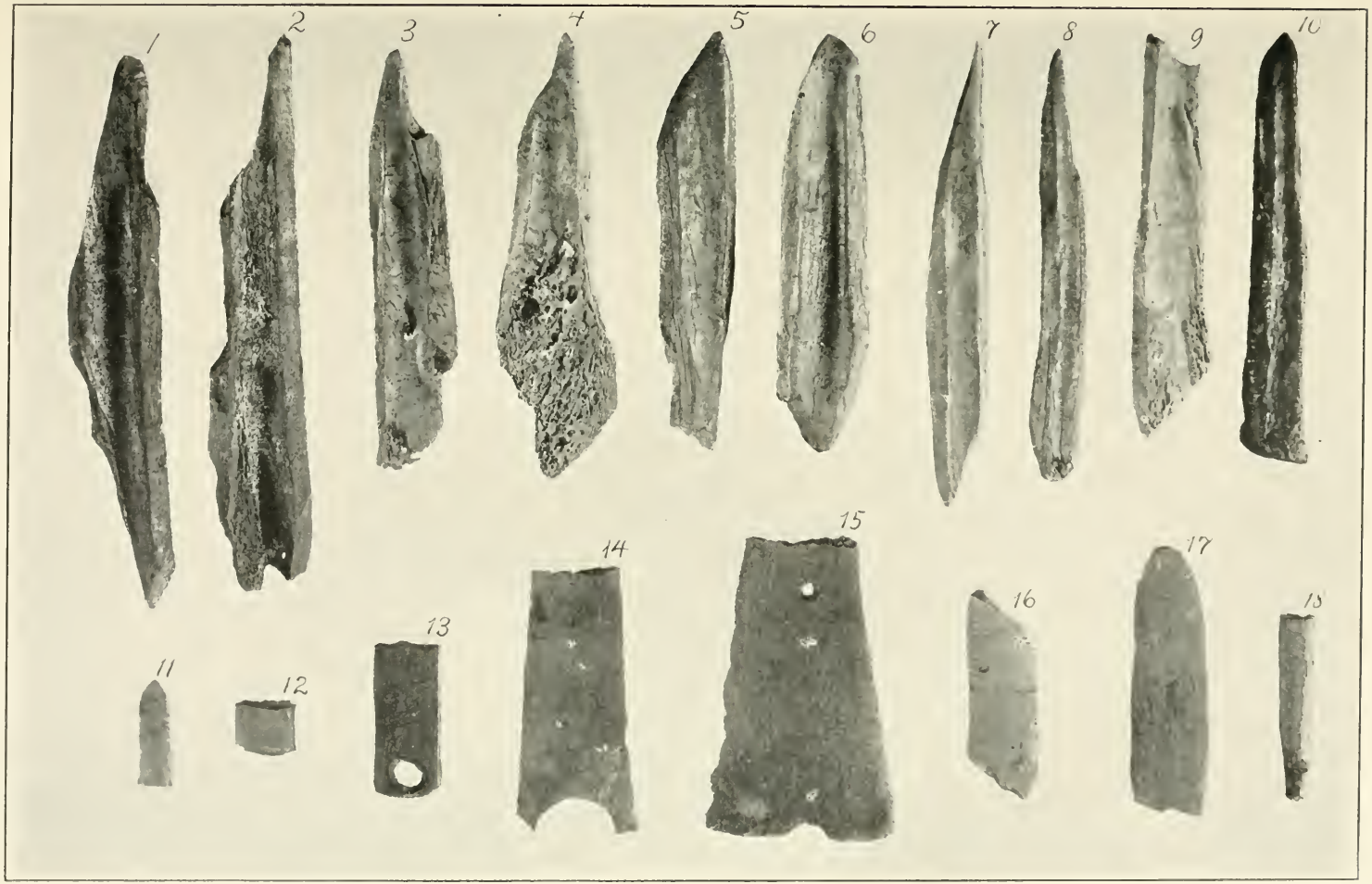
Fig. 1 (1–9007)
Fig. 2 (1–9095)
Fig. 3 (1–8551)
Fig. 4 (1–9031)
Fig. 5 (1–9005)
Fig. 6 (1–8961)
Fig. 7 (1–9043)
Fig. 8 (1–9023)
Fig. 9 (1–9053)
Fig. 10 (1–9085)
Fig. 11 (1–8966)
Fig. 12 (1–9012)
Fig. 13 (1–9040)
Fig. 14 (1–8857)
Fig. 16 (1–?)
Fig. 17 (1–9093)
Fig. 18 (1–9012)
Fig. 19 (1–8815)
Fig. 20 (1–8929)
Fig. 21 (1–8756)



EXPLANATION OF PLATE 7.

Rough bone implements and ornaments largely from the lower layers of the mound. × ⅔.

Fig. 1 (1–8983)
Fig. 2 (1–8871)
Fig. 3 (1–9067)
Fig. 4 (1–9068)
Fig. 5 (1–8980)
Fig. 6 (1–8919)
Fig. 7 (1–8918)
Fig. 8 (1–8979)
Fig. 9 (1–8996)
Fig. 10 (1–9072)
Fig. 11 (1–8875)
Fig. 12 (1–8989)
Fig. 13 (1–8988)
Fig. 14 (1–8987)
Fig. 15 (1–8920)
Fig. 16 (1–8986)
Fig. 17 (1–8984)
Fig. 18 (1–8975)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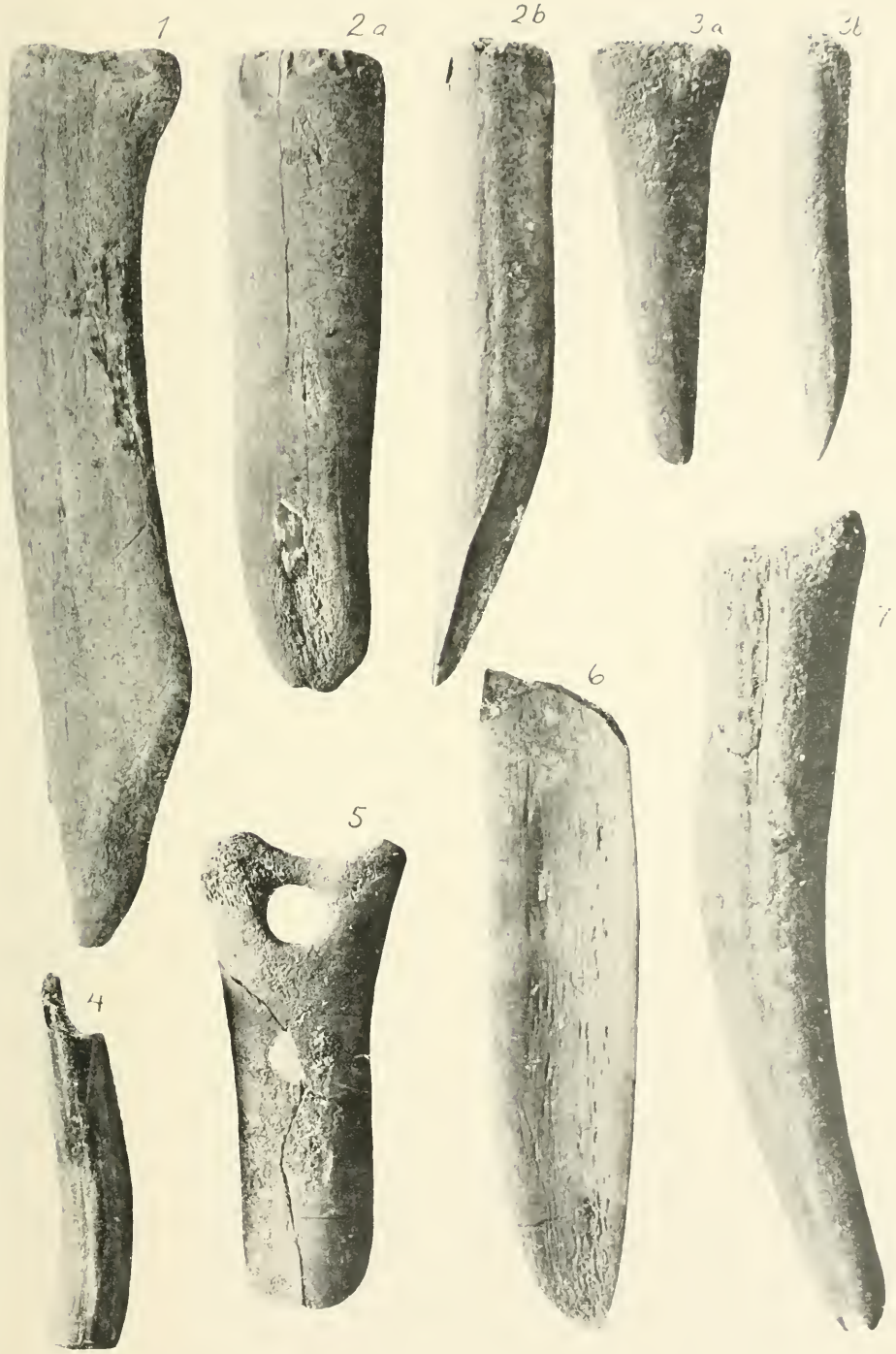
EXPLANATION OF PLATE 8.

Implements of bone and antler from the Emeryville mound. Figures about one-half natural size.

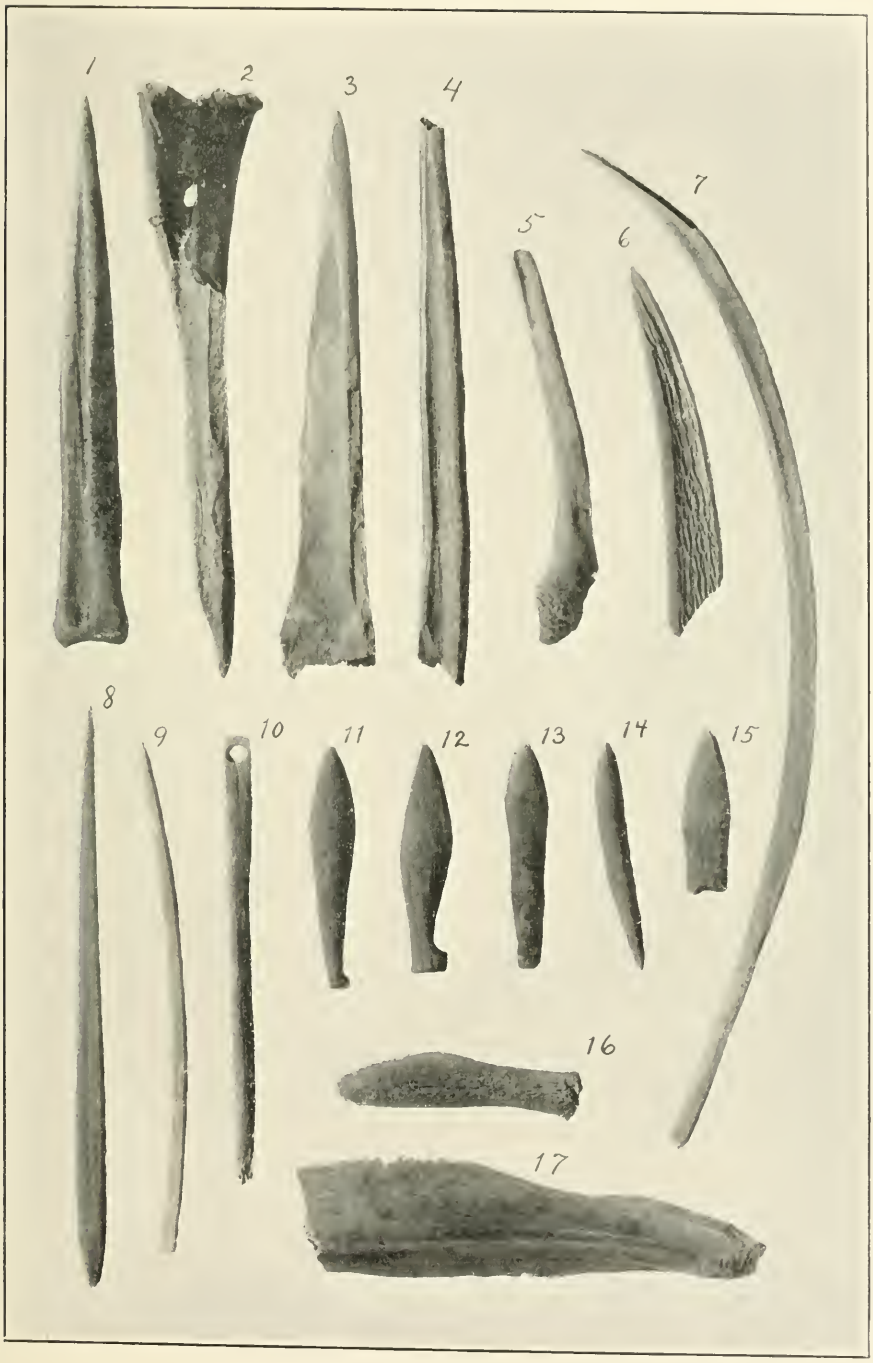
Fig. 1 (1–8730)
Figs. 2*a* and 2*b* (1–8892)
Figs. 3*a* and 3*b* (1–8821)
Fig. 4 (1–?)
Fig. 5 (1–8780)
Fig. 6 (1–8778)
Fig. 7 (1–8889)


1
2a
2b
3a
3b
4
5
6
7

EXPLANATION OF PLATE 9.

Bone implements from the Emeryville mound. $\times$ 6/10.

Fig. 1 (1–8522)
Fig. 2 (1–8686)
Fig. 3 (1–8897)
Fig. 4 (1–8972)
Fig. 5 (1–8692)
Fig. 6 (1–8985)
Fig. 7 (1–8831)
Fig. 8 (1–8895)
Fig. 9 (1–8901)
Fig. 10 (1–8735)
Fig. 11 (1–8869)
Fig. 12 (1–8868)
Fig. 13 (1–8916)
Fig. 14 (1–8917)
Fig. 15 (1–8870)
Fig. 16 (1–8694)
Fig. 17 (1–8898)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14
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16
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EXPLANATION OF PLATE 10.

Stone implements principally from the upper layers of the mound. Figures about three-fifths natural size.

Fig. 1 (1–8613)
Fig. 2 (1–8611)
Fig. 3 (1–8615)
Fig. 4 (1–8718)
Fig. 5 (1–8614)
Fig. 6 (1–8618)
Fig. 7 (1–8719)
Fig. 8 (1–8616)
Fig. 9 (1–8925)
Fig. 10 (1–8610)
Fig. 11 (1–8633)
Fig. 12 (1–8536)
Fig. 13 (1–8676)
Fig. 14 (1–8883)
Fig. 15 (1–8926)
Fig. 16 (1–8634)


1
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3
4
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6
9
10
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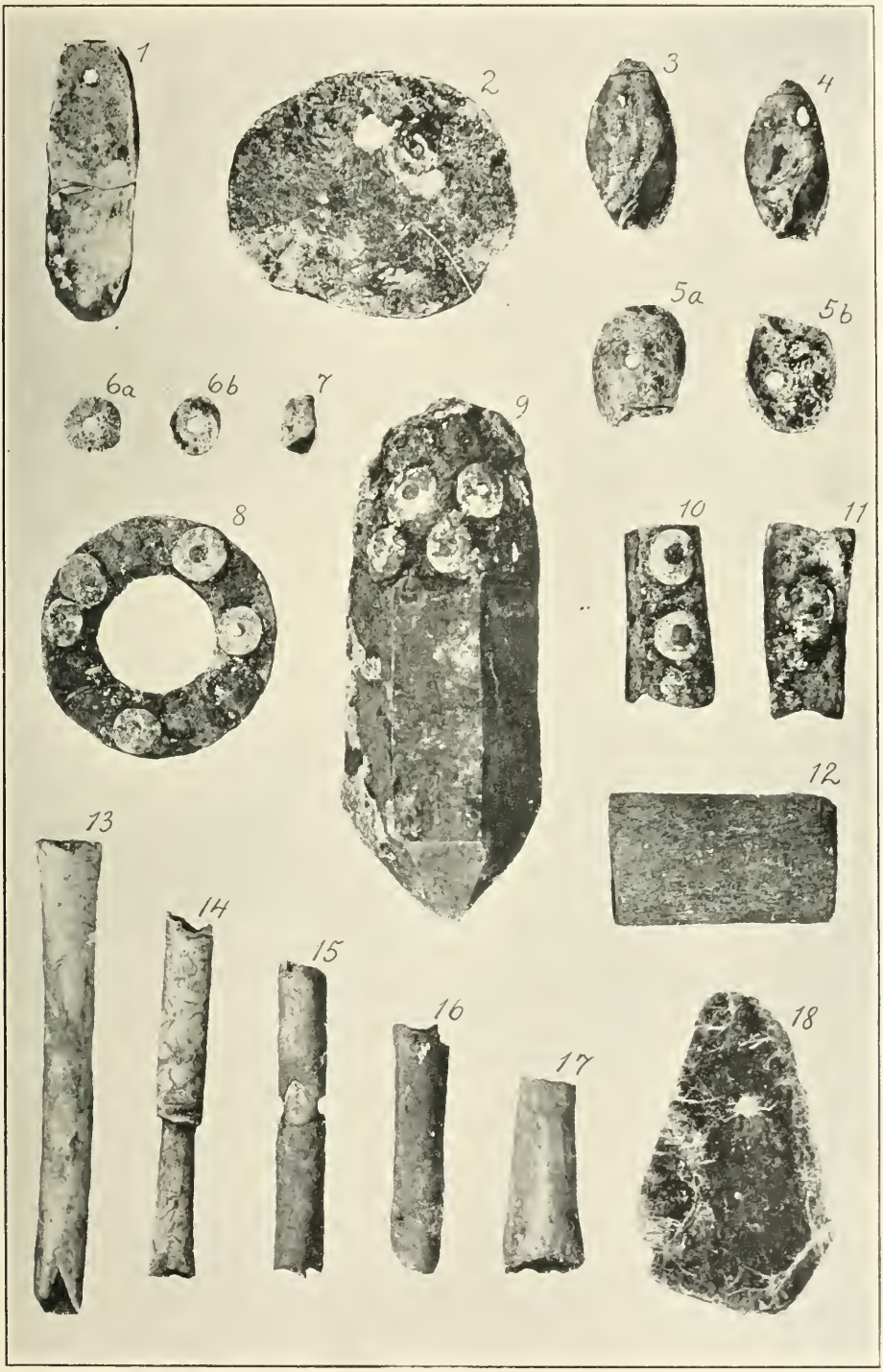
11
12
13
14
15
16

EXPLANATION OF PLATE 11.

Ornaments principally from the upper and middle layers of the mound. Natural size.

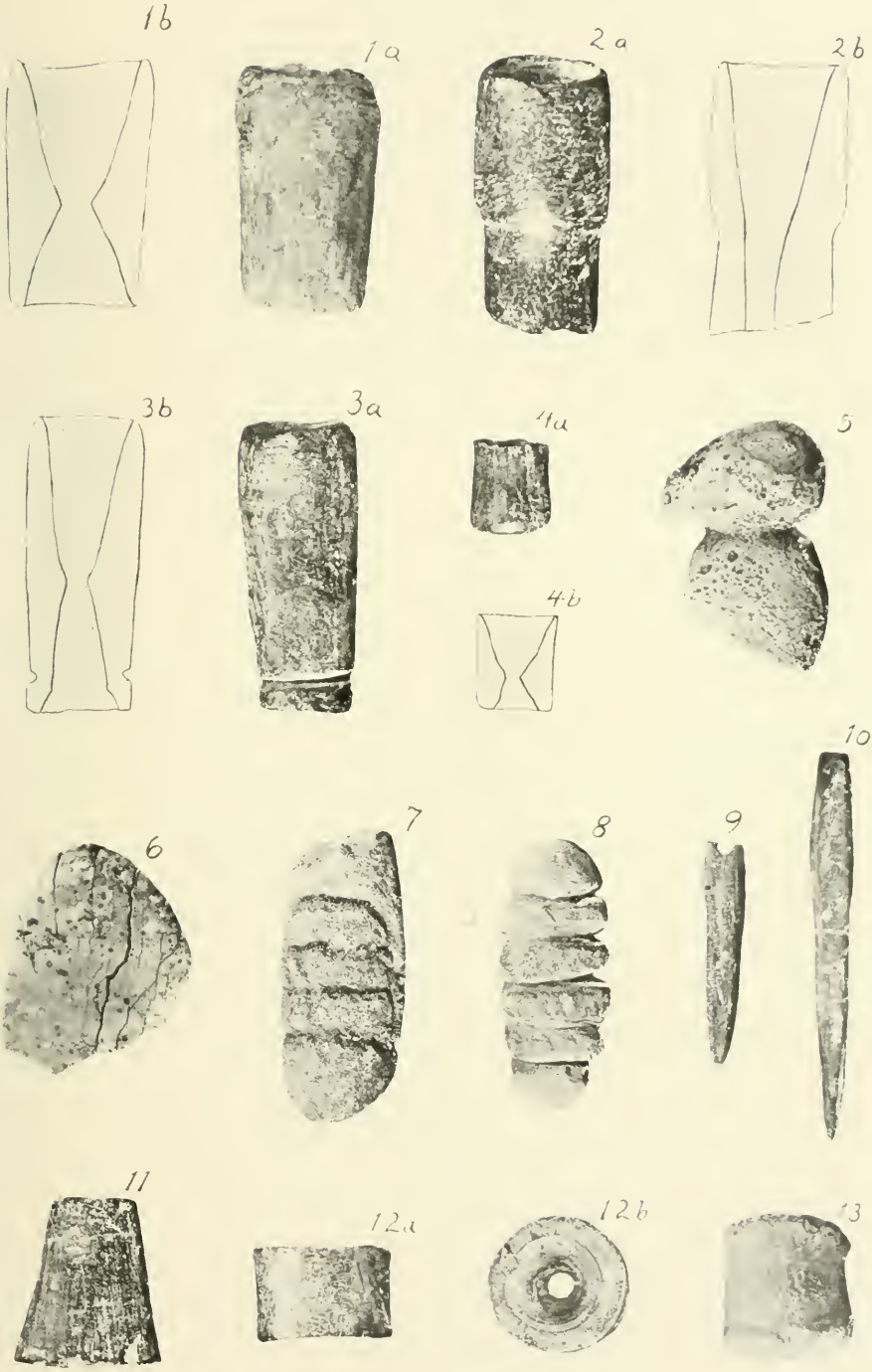
Fig. 1 (1–8777)
Fig. 2 (1–8784)
Fig. 3 (1–8879)
Fig. 4 (1–8775)
Figs. 5*a* and 5*b* (1–?)
Figs. 6*a* and 6*b* (1–8788)
Fig. 7 (1–?)
Fig. 8 (1–8783)
Fig. 9 (1–8791)
Fig. 10 (1–?)
Fig. 11 (1–?)
Fig. 12 (1–8843)
Fig. 13 (1–8702)
Fig. 14 (7–8743)
Figs. 15, 16, and 17 (1–8776)
Fig. 18 (1–8766)


1
2
3
4
5a
5b
6a
6b
7
8
9
10
11
12
13
14
15
16
17
18

EXPLANATION OF PLATE 12.

Various artifacts principally from the upper layers of the mound. Figures 1 to 4, × ¾; figures 5 to 13, × ⅔.

Figs. 1*a* and 1*b* (1–8624)
Figs. 2*a* and 2*b* (1–8622)
Figs. 3*a* and 3*b* (1–8623)
Figs. 4*a* and 4*b* (1–8626)
Fig. 5 (1–8850)
Fig. 6 (1–8631)
Fig. 7 (1–8535)
Fig. 8 (1–8630)
Fig. 9 (1–8711)
Fig. 10 (1–8608)
Fig. 11 (1–8620)
Figs. 12*a* and 12*b* (1–8671)
Fig. 13 (1–8628)


1b
1a
2a
2b
3b
3a
4a
5
4b
6
7
8
9
10
11
12a
12b
13

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